FINAL

Remedial Investigation Report for Installation Restoration Program Operable Unit 6, Iowa Army Ammunition Plant, Middletown, Iowa[1]

Contract No. W912QR12D0005, Delivery Order 0006
Contract No. W912QR21D0019, Delivery Order W912QR21F0421

Prepared for

U.S. Army Corps of Engineers
Louisville District

600 Dr. Martin Luther King Jr. Place
Louisville, Kentucky 40202-2232

August 2023

[1] Line 1, Line 1 Impoundment, Line 2, Line 3, Line 3A, Lines 5A/5B, Line 800 and Pinkwater Lagoon, and Line 9.

Executive Summary

This Remedial Investigation (RI) Report for Operable Unit 6 (OU-6) presents the results of RI activities for 10 environmental sites within 8 areas at the Iowa Army Ammunition Plant (IAAAP), in Middletown, Iowa: Line 1 Ammo LAP (Load, Assemble, and Pack) (CC-IAAP-001G), Line 1 Former Wastewater Impoundment (IAAP-016 and IAAP-016G), Line 2 Ammo LAP (IAAP-002G), Line 3 Ammo LAP (IAAP-003G), Line 3A Ammo LAP (IAAP-004G), Lines 5A and 5B Ammo Assembly (IAAP-006G), Line 9 Ammo LAP (IAAP-010G), Line 800 and Pinkwater Lagoon (IAAP-044 and IAAP-044G). The RI was conducted in accordance with the *Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa* (CH2M, 2017a) and was completed under two contracts with the U.S. Army Corps of Engineers, Louisville District: W912QR-12-D-0005, Delivery Order 0006, and W912QR21D0019, Delivery Order W912QR21F0421.

The IAAAP consists of 19,011 acres adjacent to Middletown, in Des Moines County, Iowa (Figure 1-1). It is approximately 8 miles west of Burlington, which with a population of 25,436, is the largest city in Des Moines County. The IAAAP is an active Joint Munitions Command facility currently operated by civilian contractor American Ordnance, LLC. The current mission of the IAAAP is to load, assemble, and pack ammunition items, including projectiles, mortar rounds, warheads, demolition charges, and munitions components such as fuses, primers, and boosters.

Due to explosives-contaminated surface water leaving the installation boundaries, the IAAAP was placed on the National Priorities List in August 1990. In September 1990, a Federal Facility Agreement (FFA) was signed by the U.S. Environmental Protection Agency (USEPA) Region 7 and the U.S. Army; it became effective in December 1990. Through the FFA, the U.S. Army works with the USEPA, with support provided by the Iowa Department of Natural Resources (IDNR). In accordance with the FFA, "site" refers to the IAAAP and any areas contaminated by the migration of hazardous substances from the IAAAP. The term "site" is used to refer to the environmental solid waste management units and areas of concern at the IAAAP (such as IAAP-019); this is consistent with Section IX.B of the 2018 Resource Conservation and Recovery Act (RCRA) Permit for the IAAAP.

The IAAAP was placed under the U.S. Department of Defense Installation Restoration Program (IRP), which follows the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) process, as amended by the Superfund Amendments and Reauthorization Act. In July 2002, several areas of the IAAAP previously used by the former Atomic Energy Commission were designated by the U.S. Army Corps of Engineers to be under the Formerly Utilized Sites Remedial Action Program (FUSRAP) and therefore were subsequently removed from the U.S. Department of Defense IRP (U.S. Army, 2007).

The IAAAP is currently divided into eight operable units, described below (USACE, 2016):

- OU-1 (soils): soil on the IAAAP other than those contaminated by use or testing of military munitions or by radiological chemicals.
- OU-3 (offsite groundwater): groundwater outside of the IAAAP boundary.
- OU-4 (Inert Disposal Area): the Inert Disposal Area and its associated landfills, trenches, and sedimentation ponds.
- OU-5 (Military Munitions Response Program): Military Munitions Response Program sites.
- OU-6 (onsite groundwater): groundwater within the IAAAP boundary.
- OU-7 (Installation-wide): miscellaneous IAAAP sites not included in the other OUs.

- OU-8 (FUSRAP): sites contaminated by radiological and other contaminants by former Atomic Energy Commission activities and now being addressed by FUSRAP.
- OU-9 (construction): construction debris disposal sites.

OU-2 was also established originally for soil removal actions but was subsequently merged into OU-1. OU-4 was originally considered in the installation-wide OU; however, in October 2009, the previously unaddressed areas of soil contamination were placed in OU-7, and the Inert Disposal Area remained in OU-4 (Tetra Tech, 2011a). Because the Compliance Cleanup (CC) sites were managed under RCRA, they do not currently fall within an OU.

To streamline the CERCLA process, three new OU divisions (OU-10, OU-11, and OU-12) are being proposed based on recommended remedial actions for the IAAAP sites. The OU-10 grouping is proposed for IAAAP groundwater sites in the Explosives Disposal Area. The OU-11 grouping is proposed for miscellaneous IAAAP sites that warrant a No Further Action (NFA) decision. The OU-12 grouping is proposed for IAAAP sites that were formally managed under the CC program. This RI report includes environmental sites that are recommended for inclusion in existing OUs [OU-6 (onsite groundwater) and OU-7 (installation-wide)].

The overall objectives of this RI were to update the conceptual site model for each IAAAP area, assess the potential for unacceptable human health risks and hazards and the potential for ecological impacts (including identification of chemicals of concern [COCs] or chemicals of ecological concern), and recommend a path forward consistent with the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final* (USEPA, 1988). This report presents the results of RI activities for the IAAAP sites within the eight areas at the IAAAP listed in the subsections below.

Background values were established for metals in soil and groundwater at IAAAP; the same background data sets were used for both the human health and ecological risk evaluations. The soil background values were obtained from the *Reevaluation of Background Concentrations of Metals in Soil* (Jacobs, 2022). Groundwater background values were obtained from *Evaluation of Background Concentrations of Metals in Groundwater* (CH2M, 2020a).

This RI document reflects certain procedural departures from the standard USEPA Human Health Risk Assessment (HHRA) process that the Army routinely applies at its installations (USEPA, 1989). An example is the inclusion in the HHRA of onsite detected chemicals with concentrations that are either the same or less than those of their respective site-specific background concentrations (naturally occurring chemicals). Such an approach adds extraneous information into the HHRA process.

However, this background comparison method is consistent with Worksheet #14 of the *Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa* (UFP-QAPP) (CH2M, 2017a). Although inconsistent with the process the Army uses for background in the HHRA for their installations, this method complies with the requests from the USEPA in a memorandum from the USEPA Region 7 Remedial Project Manager to the IAAAP Project Manager (USEPA, 2019).

IAAAP Site-specific Descriptions and Remedial Investigation Conclusions

This report presents the results of RI activities for 10 environmental sites within 8 areas.

CC-001G_Line 1 Groundwater (19105.1065)

This area comprises groundwater at the Line 1 LAP (missile/former Atomic Energy Commission) (hereinafter Line 1), which encompasses 231 acres and is located in the northeastern quadrant of the

IAAAP, and is immediately east of Brush Creek (Figure 5.1-1). Soil at Line 1 is addressed under the remedy for OU-1 (IAAP-001) (Leidos, 2018). The Line 1 area historically contained more than 200 buildings and associated facilities; several of the buildings have been recently demolished or are scheduled for demolition as part of IAAAP's facility demolition plan (IAAAP, 2023). Ammunition was produced at Line 1 from 1941 until August 1945. Production resumed in 1948 under the control of the Atomic Energy Commission to fabricate explosive components for nuclear weapons; the Atomic Energy Commission operated Line 1 until 1975, when operation returned to Army-controlled production of ordnance. Historical surface runoff at Line 1 has flowed to ephemeral ditches and Brush Creek.

Potential sources of contamination at Line 1 include historical activities associated with explosives-related processing, assembly, and shipping at various buildings within Line 1, and wastewater treatment at Building 1-70. The major feedstocks historically used at Line 1 included 2,4,6-trinitrotoluene (TNT), lead azide, barium nitrate, mercury fulminate, plastic bonded explosive (PBX), and antimony sulfate (JAYCOR, 1994a). Metal-cleaning operations, which may have used chromic acid, were also once performed at Line 1 (JAYCOR, 1994a). Primary release points/mechanisms include former wastewater sumps and/or clarifiers at former Buildings 1-05-1, 1-05-2, and 1-08-1 and existing Buildings 1-12 and 1-10; wastewater troughs/discharge points from former Buildings 1-05-1 and 1-05-2; and wastewater discharges and spills and rainwater/groundwater pumping from former subterranean Building 1-40. Active discharges at Line 1 ceased in 1997.

Based on historical site operations and a comparison of the most current concentration data (Table 5.1-5) to site characterization project action limits (PALs) and background threshold values (BTVs), explosives (Royal Demolition Explosive [RDX]; TNT, 2,4-dinitrotoluene [DNT]; 2,6-DNT; and 2-nitrobenzene) and manganese were identified as potential site-related chemicals of interest in groundwater. Note that chemicals of interest were identified for nature and extent discussion and differ from chemicals of potential concern (COPCs) identified in the risk assessment. RDX is the most extensive chemical, and the other explosives are present within the RDX plume extents. RDX is present primarily in two larger, greater-concentration plumes and four smaller, lower-concentration plumes. The largest RDX plume is downgradient of former operational Buildings 1-05-1, 1-05-2, 1-70-1, and 1-100. Total manganese was detected at a concentration greater than its PAL and BTV at only one location (JAW-41). This well is located outside and downgradient of the explosives plume footprint. This suggests that manganese is not associated with a site release and may be naturally occurring due to localized geochemical conditions and natural reductive dissolution. The lateral and vertical extents of contamination are delineated at Line 1.

Line 1 consists of buildings, roads, railroad tracks, and drainage ditches, which are surrounded by grass-covered areas. Contaminants have entered groundwater at Line 1 due to the historical discharge of process water from buildings, sumps, and clarifiers and the subsequent leaching of chemicals through the unsaturated zone soil. The groundwater table at Line 1 is shallow, and groundwater in the overburden aquifer was encountered at less than 10 feet below ground surface (bgs). Contaminants in groundwater have been transported from the source release areas through advection and dispersion at Line 1. Anaerobic daughter products of RDX were detected at Line 1 at the majority of wells with RDX detections, providing evidence that anaerobic biodegradation of RDX has occurred in groundwater at Line 1. However, concentration trends based on a monitoring well within the plume core show RDX concentrations fluctuating, with no overall increasing or decreasing trend, providing inconclusive data for natural attenuation. Nevertheless, the physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in downgradient wells.

The HHRA conducted for Line 1 indicates that the risk and hazard estimates for at least one receptor exceed EPA's target risk range of 1×10^{-6} to 1×10^{-4} and the hazard index target of 1. Therefore, COCs were identified for exposure scenarios summarized below.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals in groundwater at Line 1. The cumulative cancer risk estimate was 9×10^{-4}, and two target organ hazard index (HI) estimates were greater than 1 (hepatic and nervous system). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at Line 1 are TNT (9.5 micrograms per liter [µg/L]), 2-amino-4,6-DNT (16 µg/L), 4-amino-2,6-DNT (11 µg/L), 2,4-DNT (0.57 µg/L), 2,6-DNT (0.086 µg/L), 2-nitrotoluene (3.7 µg/L), and RDX (837 µg/L).

The HHRA also identified potential unacceptable risks and hazards in groundwater for future site workers. The cumulative cancer risk estimate was 2×10^{-4}, and two target organ HI estimates were greater than 1 (hepatic and nervous system). The COCs, and corresponding exposure point concentrations, identified for future site workers at Line 1 are TNT (9.5 µg/L), 2-amino-4,6-DNT (16 µg/L), 2-nitrotoluene (3.7 µg/L), 4-amino-2,6-DNT(11 µg/L), and RDX (837 µg/L).

No unacceptable risks and hazards were identified for the construction/utility worker; the cumulative risk and target organ HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. The Ecological Risk Assessment (ERA) concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective at Line 1, given the lack of complete exposure pathways for ecological receptors.

IAAP-016_Line 1 Former Wastewater Impoundment (19105.1020)—Soil, Surface Water, and Sediment and IAAP-016G_Line 1 Former Wastewater Impoundment Groundwater (19105.1075)

This area comprises groundwater, soil, sediment, and surface water at the Line 1 Impoundment, which is located southwest of Line 1, includes a former wastewater impoundment pond that is approximately 1,300 feet long and that parallels Brush Creek (Figure 5.1-1). The former wastewater impoundment pond is a constructed feature that was used to impound explosives-contaminated water from Line 1 prior to its discharge into Brush Creek. The former Line 1 Impoundment was created in 1948 when a dam was constructed along the upper reaches of Brush Creek to impound effluent discharged from Line 1 (Dames and Moore, 1989a; Tetra Tech, 2006b). The Line 1 Impoundment was used to allow particulates from explosives-contaminated wastewater to settle prior to the wastewater being discharged downstream. In 1997, active discharge to Brush Creek from Line 1 operations ceased, Brush Creek was rerouted around the Line 1 Impoundment, and an interim remedial action was implemented (Tetra Tech, 2006b). Historical surface runoff at the Line 1 Impoundment has flowed to Brush Creek.

The source of contamination at the Line 1 Impoundment includes the historical deposition of explosives-contaminated wastewater, coal fragments, and fly ash within the former impoundment. In 1997, active discharge to Brush Creek from Line 1 operations ceased.

Based on historical site operations and a comparison of the most current concentration data (Tables 5.2-3 through 5.2-5) to site characterization PALs and BTVs, metals and explosives were identified as site-related chemicals of interest. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. In groundwater, potential chemicals of interest include explosives (RDX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) and manganese. Explosives contamination in groundwater is present as a relatively small, shallow plume on the southern end of the former impoundment. Manganese is not associated with historical operations at the Line 1 Impoundment, and elevated manganese concentrations in groundwater at Line 1 may be naturally occurring due to localized geochemical conditions. In surface water at the Line 1 Impoundment, potential site-related chemicals of interest include explosives (RDX, hot melt explosive [HMX], TNT, 2-amino-4,6-DNT, and 4-amino-2,6-DNT). In sediment at the Line 1 Impoundment, potential site-related chemicals of interest include explosives (RDX, HMX, TNT, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) and polycyclic aromatic hydrocarbons. Soil and impoundment pond surface water and sediment have been addressed under an interim remedial action, which included a non–time critical removal action for soil and sediment, rerouting of Brush Creek around the west side of the former impoundment, construction of a water treatment system and hydraulic relief structure, construction of a phytoremediation wetland, treatment system and phytoremediation sampling, and operation and maintenance (O&M) activities.

The Line 1 Impoundment currently consists of a treatment wetland and pond that is surrounded and covered by grass and other vegetation. The ground topography slopes toward Brush Creek and toward the center of the pond. The groundwater table at the site is shallow, and groundwater in the overburden aquifer was encountered at less than 10 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Contaminants have entered sediment and surface water in Brush Creek primarily from other sources than the impoundment, such as historical Line 1 permitted discharge of explosives through outfalls to Brush Creek. The treatment wetland should continue to reduce concentrations of explosives in sediment and surface water within the impoundment pond. Anaerobic daughter products of RDX were detected in groundwater at the Line 1 Impoundment, providing evidence that anaerobic biodegradation of RDX has occurred. However, concentration trends based on a monitoring well within the plume core show RDX concentrations fluctuating, with no overall increasing or decreasing trend, providing inconclusive data for natural attenuation. Nevertheless, the physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in downgradient wells. The lateral and vertical extents of contamination in groundwater at the Line 1 Impoundment are delineated.

The HHRA conducted for the Line 1 Impoundment indicates that the risk and hazard estimates for at least one receptor exceed EPA's target risk range of 1×10^{-6} to 1×10^{-4} and the hazard index target of 1. Therefore, COCs were identified for exposure scenarios summarized below.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals in groundwater at the Line 1 Impoundment. The cumulative cancer risk estimate was 3×10^{-3}, and two target organ HI estimates were greater than 1 (hepatic and nervous system). The COCs and corresponding exposure point concentrations identified for future residential exposures at the Line 1 Impoundment are manganese (dissolved) (2,810 µg/L), TNT (1.5 µg/L), 2-amino-4,6-DNT (4.3 µg/L), 4-amino-2,6-DNT (7.4 µg/L), HMX (600 µg/L), and RDX (3,200 µg/L).

The HHRA also identified potential unacceptable risks and hazards in groundwater for future site workers. The cumulative cancer risk estimate was 8×10^{-4}, and one target organ HI estimate was greater than 1 (nervous system). The COCs and corresponding exposure point concentrations identified for future site workers at Line 1 Impoundment are manganese (dissolved) (2,810 µg/L) and RDX (3,200 µg/L). No unacceptable risks and hazards were identified for the construction/utility worker; the cumulative risk and target organ HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. No chemicals in surface water and sediment from Brush Creek exceeded screening levels; therefore, no COPCs were identified for these media.

Because a portion of Brush Creek runs through the Line 1 Impoundment boundary, surface water and sediment at this site were evaluated under the *Watershed Ecological Risk Assessment for Remedial Investigations at Iowa Army Ammunition Plant, Middletown, Iowa* (CH2M, 2022). No chemicals of potential ecological concern were identified for Brush Creek (the watershed containing the site) during the watershed ERA (CH2M, 2022). Therefore, the ERA concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective at the Line 1 Impoundment Area. Additionally, an interim remedial action is in place that addresses explosives within the impoundment pond; therefore it can be inferred that historical data are overly conservative of current onsite conditions.

IAAP-002G_Line 2 Ammo LAP (Artillery/Shape) Groundwater (19105.1003)

This area comprises groundwater at the Line 2 Ammo LAP (Artillery/Shape) (Line 2), which encompasses a 140-acre active site in the north-central portion of the IAAAP, located south of Line 1 (Figure 5.3-1). Soil at Line 2 is addressed under the remedy for OU-1 (IAAP-002) (Leidos, 2018). Line 2 is used to load, assemble, and pack 120-millimeter ammunition and blank ammunition. The site consists of 31 buildings and covered walkways and includes equipment rooms, explosives magazines, and nine sump buildings (Tetra Tech, 2016). The site has been in operation as an LAP line since IAAAP was constructed, in 1941, except for a temporary shutdown period from 1947 to 1949 (JAYCOR, 1996). Prior to the implementation of the National Pollutant Discharge Elimination System (NPDES) outfalls, untreated wastewater containing dissolved explosives was directly discharged to sumps and surface drainage ditches located adjacent to Buildings 2-05-1 and 2-05-2 (URS, 2004b). In the early 1970s, two wastewater treatment buildings were constructed, and NPDES Outfalls 21 and 22 were established. Currently, none of the Line 2 buildings (including the melt buildings) discharges explosives-contaminated wastewater. Historical surface runoff at Line 2 has flowed to ditches and intermittent tributaries that join Brush Creek.

The source of contamination at Line 2 is attributed to wastewater management and LAP activities at the site. During the Preliminary Assessment, wastes found at Line 2 were predominantly explosives. Other potential wastes included solvents and oils, which could have discharged into the sumps before the wastewater treatment plant was operative or before the solvent recovery system was installed.

Based on historical site operations and a comparison of the most current concentration data (Table 5.3-5) to site characterization PALs and BTVs, explosives (RDX, 4-amino-2,6-DNT, 2-amino-4,6-DNT, and nitrobenzene) were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Explosives contamination is present as two plumes, a larger north plume and a smaller south plume. The north RDX plume is present downgradient of melt Building 2-05-2, while the south RDX plume is outside the Line 2 site boundary to the southwest, along Brush Creek. Although the south plume is outside the Line 2 boundary, it has been administratively included with Line 2 because of its proximity. Iron and manganese concentrations were also elevated in groundwater, but these are associated with the 2007–2009 treatability study, which enhanced reducing conditions in groundwater, and are not site-related. The lateral and vertical extents of contamination at Line 2 are limited.

Line 2 is an active LAP facility with buildings, covered walkways, roads, and railroad tracks that are surrounded by grass-covered areas. This site falls within the Brush Creek watershed. Surface water drainage occurs through a number of drainage ditches and culverts, which ultimately discharge to Brush Creek. The groundwater table at Line 2 is shallow, observed at overburden monitoring wells between 6 and 14 feet bgs within the Line 2 site boundary during the current RI. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Vertical migration at the site is limited by the generally tight clay lithology in the overburden. As a result, even lead-contaminated soil, which was removed in 2007, did not impact groundwater. Anaerobic daughter products of RDX were detected at wells located within the north RDX plume, providing evidence that anaerobic biodegradation of RDX has occurred in groundwater at Line 2. Decreasing concentration trends are also observed in the north RDX plume, while concentrations in the south RDX plume have fluctuated. The physical natural attenuation processes are also likely helping to stabilize the plumes, given the very limited extent of the plumes.

The HHRA conducted for Line 2 indicates that the risk and hazard estimates for at least one receptor exceed EPA's target risk range of 1×10^{-6} to 1×10^{-4} and the hazard index target of 1. Therefore, COCs were identified for exposure scenarios summarized below.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals in onsite and offsite groundwater at Line 2. The cumulative cancer risk estimate was 1×10^{-3}, and four target organ HI estimates were greater than 1 (hepatic, cardiovascular, dermal, and nervous system) for onsite groundwater. The COCs and corresponding exposure point concentrations identified for future residential exposures in onsite groundwater at Line 2 are 2-amino-4,6-DNT (7.4 µg/L), 4-amino-2,6-DNT (7.3 µg/L), HMX (160 µg/L), nitrobenzene (14 µg/L), RDX (180 µg/L), and arsenic (44.9 µg/L). For offsite groundwater at Line 2, the future residential receptor cumulative cancer risk estimate was 6×10^{-4}, and one target organ HI estimate was greater than 1 (nervous system). The COC, and corresponding exposure point concentration, identified for future residential exposures in offsite groundwater at Line 2 is RDX (590 µg/L).

The HHRA also identified potential unacceptable risks in onsite groundwater for future site workers. The cumulative cancer risk estimate was 3×10^{-4}; the target organ HI estimates were less than 1. The COCs, and corresponding exposure point concentrations, identified for future site workers in onsite groundwater at Line 2 are arsenic (44.9 µg/L) and RDX (180 µg/L) . No unacceptable risks and hazards were identified for the site worker exposures for offsite groundwater at Line 2; the cumulative risks were within the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. No unacceptable risks and hazards were identified for the construction/utility worker exposures of either onsite or offsite groundwater at Line 2; the cumulative risks were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1.The ERA concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective at Line 2, given the lack of complete exposure pathways for ecological receptors.

IAAP-003G_Line 3 Ammo LAP (Artillery) Groundwater (19105.1005)

This area comprises groundwater at the Line 3 Ammo LAP (Artillery) (Line 3), which encompasses a 149-acre active site in the central portion of IAAAP, located between Lines 9, 6, and 7 and Brush Creek (Figure 5.4-1). Soil at Line 3 is addressed under the remedy for OU-1 (IAAP-003) (Leidos, 2018). Line 3 historically consisted of 56 buildings and covered walkways, which included equipment rooms, explosives magazines, sump buildings, melt buildings, and two process-water treatment facilities (Shaw, 2004b). More than 30 buildings have been demolished as part of IAAAP's facility demolition plan (IAAAP, 2023). Line 3 began operating as a production line when the IAAAP was constructed, in 1941, and underwent a temporary shutdown from 1945 to 1949 (JAYCOR, 1996). Line 3 was largely inactive, except for mine production until 1978 and demilling activities in 1979, with production of new munitions commencing in 1979 and continuing until 1992, when operations ceased. Between 1977 and 1985, metal-cleaning operations were conducted at Line 3. Line 3 was in standby status for several years but currently is used for production of mine-clearing line charge and Stinger missile operations. Historical surface runoff at Line 3 has flowed to intermittent tributaries that join Brush Creek.

The source of contamination at Line 3 is attributed to historical explosives LAP operations and metal treatment operations at site buildings and sumps. The areas with the greatest volume of explosives wastewater occurred at the two melt buildings located in the center of the site. Other potential release sources include explosives-contaminated wastewater from sump overflows, solvent and paint remover wastes from paint-stripping and renovation activities, contaminated wastewater from production room washdowns onto the ground or into nearby drainageways, spills at material receiving docks, and dust releases from open windows and doors. The wastewater generated from metal-cleaning processes was discharged to the wastewater treatment plant at Line 3.

Based on historical site operations and a comparison of the most current concentration data (Table 5.4-3) to site characterization PALs and BTVs, explosives (2,4-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX) were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Since 2000, explosives exceedances have been observed in only one shallow overburden monitoring well, JAW-54, located near the soil removal areas and former sumps associated with melt Building 3-05-01. Groundwater samples collected downgradient of Building 3-10 did not have explosives concentrations exceeding site characterization PALs. The lateral and vertical extents of contamination are delineated.

Line 3 is primarily grass covered, with a few buildings and a few roads that lead to the demolished building footprints remaining. Surface runoff moves toward intermittent tributary that joins Brush Creek. Contaminants have entered groundwater at Line 3 due to the historical discharge of process water from buildings and sumps and the subsequent leaching of chemicals through unsaturated zone soil. The groundwater table at Line 3 is shallow, and groundwater in the overburden aquifer was encountered between 1 and 8 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Given that the overburden aquifer is composed predominantly of clays and the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow except for in the sand seams present in the aquifer. Explosives concentrations have decreased in the one well with exceedances, JAW-54, indicating that natural attenuation is occurring. Anaerobic daughter products of RDX were also detected in this well.

The HHRA conducted for Line 3 indicates that the risk and hazard estimates for at least one receptor exceed EPA's target risk range of 1×10^{-6} to 1×10^{-4} and the hazard index target of 1. Therefore, COCs were identified for exposure scenarios summarized below.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals groundwater at Line 3. The cumulative cancer risk estimate was 3×10^{-4}, and two target organ HI estimates were greater than 1 (hepatic and nervous system). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at Line 3 are 2,4-DNT (0.91 µg/L), 2,6-DNT (0.16 µg/L), 2-amino-4,6-DNT (47 µg/L), 4-amino-2,6-DNT (18 µg/L), and RDX (289 µg/L).

The HHRA also identified potential unacceptable hazards in groundwater for future site workers. One target organ HI estimate was greater than 1 (hepatic). The cumulative cancer risk estimate for the future site worker were within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}. The COCs, and corresponding exposure point concentrations, identified for future site workers at Line 3 are 2-amino-4,6-DNT (47 µg/L) and 4-amino-2,6-DNT (18 µg/L).

No unacceptable risks and hazards were identified for the construction/utility worker; the cumulative risk and target organ HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. The ERA concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective at Line 3, given the lack of complete exposure pathways for ecological receptors.

IAAP-004G_Line 3A Ammo LAP (Artillery) Groundwater (19105.1007)

This area comprises groundwater at the Line 3A Ammo LAP (Artillery) (Line 3A), which encompasses a 119-acre active site located in the southwestern quadrant of the IAAAP (Figure 5.5-1). Soil at Line 3A is addressed under the remedy for OU-1 (IAAP-004) (Leidos, 2018). The site contains approximately 64 buildings, 18 of which are related to explosives processing. Line 3A, known as a "load line," was established for the loading of large shells and bombs and began operations in 1942. Production was discontinued in 1945 but resumed in 1949 and continued until updates were made in 1989. During this time, it functioned as an artillery LAP operation. Line 3A remains active since its updates in 1989, and current operations include mine production and confidential mission activities (JAYCOR, 1996). Explosives-contaminated wastewater from LAP operations was processed through carbon filter columns and discharged to a tributary of Skunk River for Outfall 34 and to an intermittent tributary that joins Long Creek approximately 1 mile from the site for Outfall 35. Historical surface runoff at Line 3A has flowed to intermittent streams that join Skunk River.

The primary source of contamination at Line 3A is attributed to the LAP operations, including the use of TNT, RDX, MHX, ammonium nitrate; various solvents from paint-stripping and renovation operations; and metals; and from explosives-contaminated wastewater from sump overflows or spills. The sumps at Line 3A are no longer in use for processing wastewater. The site remains an active LAP line.

Based on historical site operations and a comparison of the most current concentration data (Table 5.5-5) to site characterization PALs and BTVs, one explosive (RDX) was identified as a site-related chemical of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. RDX is present as one large plume at Line 3A and exceedances were observed at six shallow overburden wells and two deep overburden locations. The maximum concentration was detected downgradient of Building 3A-05-2. The RDX plume is laterally and vertically delineated.

Line 3A is a relatively flat, active line that sits on top of a ridge dividing the Long Creek watershed to the north and the Skunk River watershed to the south. The fine-grained (clay) geology at the site should facilitate sorption of chemicals of interest and retard vertical migration by limiting leaching. RDX concentrations have increased in groundwater at several well locations between 2008 and 2018. Therefore, there may be a continuing source to groundwater at this site. This includes the two excavation areas where soil could not be removed to OU-1 remedial goals.

The HHRA did not identify any unacceptable risks or hazards for future residential receptors exposed to site-related chemicals in groundwater at Line 3A. The cumulative cancer risk estimate for hypothetical residents was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}, and all target organ HIs were less than 1. Future site worker and construction/utility worker risks and hazards were not quantified in the HHRA because the hypothetical residential scenario did not exceed acceptable risk levels, and COCs were not identified for a residential scenario; the residential scenario is considered protective of receptors with fewer exposures. The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 3A, given the lack of complete exposure pathways for ecological receptors.

IAAP-006G_Line 5A and 5B Ammo Assembly Groundwater (19105.1067)

This area comprises groundwater at Lines 5A and 5B Ammo Assembly (Lines 5A/5B), which are located in the north-central portion of the IAAAP and are bounded by Yard L to the north, Line 1 to the east, Lines 4A and 4B to the south, and Yard J to the west (Figure 5.6-1). Soil at Lines 5A/5B is addressed under the remedy for OU-1 (IAAP-006) (Leidos, 2018). Line 5A encompasses approximately 33 acres in the Brush Creek watershed and historically contained 17 buildings. Line 5B encompasses approximately 41 acres in the Long Creek watershed, west of Line 5A, and historically contained 18 buildings. All buildings at both Lines 5A and 5B have been demolished as part of IAAAP's facility demolition plan (IAAAP, 2023).

Line 5A was operated as a booster production line from 1942 until the end of World War II in 1945 and resumed in 1949 during the Korean War for pelletizing TNT, miscellaneous demolition blocks and grenades, and assembling explosive components (JAYCOR, 1996). Process wastewater was discharged from Building 5A-140-3 through an NPDES-permitted outfall to a ditch that flows south to an intermittent tributary of Brush Creek at the southern boundary of the site (MWH, 2001). This outfall is no longer used (Tetra Tech, 2006b). The site is currently inactive; production ceased between 1988 and 1991 (ECC, 2001b), and the site is no longer permitted for NPDES discharge.

Line 5B was used for pelletizing adaptor-boosting tetryl and assembling explosives components between 1942 and 1945; production resumed in 1949 just before the Korean War and was intensified in 1961 during the Vietnam War. Line 5B was later rented to Advanced Environment Technology for destructive disposal of ammunition until approximately 2005. Process wastewater was discharged through an NPDES outfall to a ditch at the north end of the site. Line 5B is currently inactive and is no longer permitted for NPDES discharge. Historical surface runoff at Lines 5A/5B has flowed to ditches and intermittent tributaries that join Brush Creek or Long Creek.

The sources of contamination at Lines 5A/5B are attributed to the historical explosives-related operations at the site buildings and to process wastewater. The principal explosives used at both lines were TNT and tetryl. Historical releases at Line 5B may have occurred at Buildings 5B-140-1, 5B-140-2, 5B-140-3, 5B-28, and 5B-29. Additionally, process wastewater generated at Lines 5A and 5B was formally discharged through NPDES Outfalls 51 and 52. Operations at the site had ended by 2005.

Based on historical site operations and a comparison of the most current concentration data (Tables 5.6-7 and 5.6-8) to site characterization PALs and BTVs, explosives (RDX, 4-Amino-2,6-DNT, and 2-Amino-4,6-DNT) were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Two small explosives plumes are present, one at Line 5A and one at Line 5B. At Line 5A, exceedances were observed only at shallow overburden well 5A-MW2. At Line 5B, exceedances were also observed at only one shallow overburden well, 5B-MW1, which is adjacent to the soil removal areas and former sumps associated with former Buildings 5B-28 and 5B140-3. The lateral and vertical extents of contamination are delineated, and the plumes are limited in extent.

Lines 5A/5B are primarily grass covered, with a few remaining roads leading to the demolished building footprints. Surface runoff in the eastern half of the site (Line 5A) moves toward an intermittent tributary of Brush Creek, whereas surface runoff in the western half of the site (Line 5B) moves to the southwest toward a tributary to Long Creek. Contaminants have entered groundwater at Lines 5A and 5B due to the historical discharge of process water from buildings and sumps and the subsequent leaching of chemicals through unsaturated zone soil. The groundwater table at Lines 5A/5B is shallow, and groundwater in the overburden aquifer was encountered between 4 and 9 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Given that the overburden aquifer is composed predominantly of clays and the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow, except for in the sand seams present in the aquifer. Anaerobic daughter products of RDX were detected at wells located both Lines 5A and 5B; however, more degradation products were observed in Line 5A groundwater. The trend graphs indicate that RDX concentrations have remained relatively stable at 5A-MW2 since 2006 while RDX concentrations have decreased at 5B-MW1 after 2007. This decrease in concentrations indicates that natural attenuation is occurring. The physical natural attenuation processes are also likely helping to stabilize the plumes, given the very limited extent of the plumes.

Risks were assessed separately for Lines 5A and 5B due to the large size of each line (Line 5A is 33 acres and Line B is 41 acres), the separation distance between the two lines, and the presence of individual plumes at each line. The HHRA conducted for Line 5A indicates that the risk and hazard estimates for at least one receptor exceed EPA's target risk range of 1×10^{-6} to 1×10^{-4} and the hazard index target of 1. Therefore, COCs were identified for exposure scenarios summarized below.

The HHRA identified potential unacceptable hazards for future residential receptors exposed to site-related chemicals in groundwater at Line 5A. One target organ HI estimate was greater than 1 (hepatic). The cumulative cancer risk estimate for hypothetical residents was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}. The COCs, and corresponding exposure point concentrations, identified for future residential exposures at Line 5A are 2-amino-4,6-DNT (6.9 µg/L) and 4-amino-2,6-DNT (43 µg/L).

The HHRA also identified potential unacceptable hazards for future site workers exposed to site-related chemicals in groundwater at Line 5A. One target organ HI estimate was greater than 1 (hepatic). The cumulative cancer risk estimate for site workers was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}. The COCs, and corresponding exposure point concentrations, identified for future site worker exposures at Line 5A are 2-amino-4,6-DNT (6.9 µg/L) and 4-amino-2,6-DNT (43 µg/L). The cumulative cancer risk estimates for future construction/utility workers at Line 5A were within USEPA's target risk range of 1 × 10^{-6} to 1 × 10^{-4}, and all target organ HIs were less than 1. For Line 5B, the cumulative cancer risk estimate for hypothetical residents was within USEPA's target risk range of 1 × 10^{-6} to 1 × 10^{-4}, and all target organ HIs were less than 1. Future site worker and construction/utility worker risks and hazards at Line 5B were not quantified in the HHRA because the hypothetical residential scenario did not exceed acceptable risk levels, and COCs were not identified for a residential scenario; the residential scenario is considered protective of receptors with fewer exposures. The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 5A or Line 5B, given the lack of complete exposure pathways for ecological receptors at these sites.

IAAP-044_Line 800 and Pinkwater Lagoon (19105.1048)—Soil, Surface Water, and Sediment and IAAP-044G_Line 800 and Pinkwater Lagoon Groundwater (19105.1049)

This area comprises groundwater at Line 800 and Pinkwater Lagoon, and soil, sediment, and surface water at Pinkwater Lagoon. This area encompasses approximately 18 acres in the central part of the IAAAP (Figure 5.7-1). Soil within the Line 800 portion of the site is addressed under the remedy for OU-1 (IAAP-011) (Leidos, 2018). The site includes over 20 former buildings and structures that are encompassed by a security fence. Pinkwater Lagoon is an approximately 9-acre area adjacent to and southeast of Line 800. Line 800 was constructed in 1941. From 1943 to 1955, the primary functions of the line were renovating medium- to major-caliber shells and bombs for reprocessing and reconditioning and repainting shells and bomb casings (Tetra Tech, 2006a). Line 800 was put back into operation during the late 1950s and early 1960s and is thought to have been used on an as-needed basis until the beginning of the Vietnam War (TN & Associates, 2003a). In 1968, an inert preassembly and inspections operation began in former Building 800-04. Of note is that liquid Freon was used to reduce the sensitivity of lead azide when loading, packing, and storing mines. In 1973 a pinkwater treatment plant was completed to treat a paint-stripping/metal-cleaning facility. In 1980, the assembly of blank ammunition was the principal activity at Line 800. From 1983 to 1989, remote sawing of explosives items, remote core drilling, and remote disassembly of projectiles supported other IAAAP production lines (TN & Associates, 2003a). Line 800 is no longer in use, since the remaining buildings were demolished as part of IAAAP's facility demolition plan (IAAAP, 2023).

Pinkwater Lagoon was originally constructed in 1943 as a leaching field for wastewater. It received explosives wastewater and sludges from adjacent Line 800 production facilities and various locations at the IAAAP from 1943 to the 1970s. The lagoon was used until 1970 as a settling pond to reduce particulates before process water was discharged to surface drainage to Brush Creek, and in the early 1970s, a carbon filter system was installed to treat process water (JAYCOR, 1996). Historical surface runoff at Line 800 and Pinkwater Lagoon has flowed to intermittent tributaries that join Brush Creek or Long Creek.

Potential sources of contamination at Line 800 include historical releases of explosive compounds associated with ammunition production. The primary explosive compounds historically used at Line 800 included TNT, RDX, Composition B, black powder, HMX, and pentaerythritol. Primary release points/mechanisms include former wastewater sumps, melt buildings, and screening buildings. Active discharges at Line 800 ceased in 1997. Potential sources of contamination at the Line 800 Pinkwater Lagoon include explosives-contaminated effluent and metals-contaminated sludge disposed in the lagoon while it was in use as a settling pond to reduce particulates before discharge to surface drainage to Brush Creek, and subsequent historical leaching through soil and sediment at the bottom of the pond.

Based on historical site operations and a comparison of the most current concentration data (Table 5.7-5) to site characterization PALs and BTVs, explosives (1,3,5-TNB, 1,3-DNB, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, HMX, nitrobenzene, and RDX), Freon 113, and 1,2-dichloroethane were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Explosives contamination in groundwater is present as a large, shallow plume that extends from the southeastern portion of Line 800 and runs beneath the Pinkwater Lagoon. RDX is the most extensive chemical, and the other explosives are present within the RDX plume extents. The greatest RDX concentration was reported at the southwest edge of the lagoon. The lateral and vertical extents of the explosives plume have been defined. Soil, surface water, and sediment in the pond at the Pinkwater Lagoon have been addressed via the interim remedial action, which includes non–time critical removal action for soil/sediment, construction of a berm across the lagoon to separate the large and small pools of the lagoon, installation of outlet works to control discharges to the Brush Creek tributary, installation of a temporary granular activated carbon treatment system, construction of a 9-acre phytoremediation wetland and treatment system, phytoremediation sampling, and other O&M activities.

Line 800 consists of buildings, roads, railroad tracks, and drainage ditches, which are surrounded by grass-covered areas. The Line 800 Pinkwater Lagoon currently consists of a treatment wetland and two lagoon ponds that are surrounded by a grassy berm and other vegetation. Due to a topographic divide at the site, at which the ground surface slopes gently to the southeast and to the southwest, Line 800 and Pinkwater Lagoon fall within both the Long Creek watershed and the Brush Creek watershed. Surface water in the pond is subject to controlled discharge to the Brush Creek tributary north of the lagoon. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Although a downward vertical gradient is evident at well pairs throughout the site, the lack of elevated contaminant concentrations in bedrock groundwater samples indicates vertical migration at the site is limited by the generally tight clay lithology in the overburden. Anaerobic daughter products of RDX were detected at most wells with RDX detections, providing evidence that anaerobic biodegradation of RDX has occurred in groundwater at Line 800 and Pinkwater Lagoon. Overall, concentration trend data also provide supporting evidence for natural attenuation or enhanced biodegradation of explosives due to the treatability study at Line 800 and Pinkwater Lagoon. Physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in cross-gradient and downgradient wells.

The HHRA conducted for Line 800 and Pinkwater Lagoon indicates that the risk and hazard estimates for at least one receptor exceed EPA's target risk range of 1×10^{-6} to 1×10^{-4} and the hazard index target of 1. Therefore, COCs were identified for exposure scenarios summarized below.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals groundwater at Line 800 and Pinkwater Lagoon. The cumulative cancer risk estimate was 1×10^{-3}, and five target organ HI estimates were greater than 1 (no observable effect [NOE], gastrointestinal, hepatic, immune, and nervous system). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at the Line 800 and Pinkwater Lagoon are iron (120,025 µg/L—tap water), manganese (12,792 µg/L—tap water), 1,3-dinitrobenzene (7.6 µg/L—tap water), TNT (174 µg/L—tap water), 2,4-DNT (12 µg/L—tap water), 2,6-DNT (4.0 µg/L—tap water), 2-amino-4,6-DNT (25 µg/L—tap water), 2-nitrotoluene (0.51 µg/L—tap water), 3-nitrotoluene (7.8 µg/L—tap water), 4-amino-2,6-DNT (28 µg/L—tap water), nitrobenzene (3.4 µg/L—tap water), RDX (974 µg/L—tap water), Freon 113 (39,800 µg/m^3—indoor air; 2,900 µg/L—tap water), and 1,2-DCE (6.2 µg/L—tap water). The HHRA also identified potential unacceptable risks and hazards for future site workers. The cumulative cancer risk estimate was 3×10^{-4}, and three target organ HI estimates were greater than 1 (NOE, hepatic, and nervous system). The COCs, and corresponding exposure point concentrations, identified for future site worker exposures at the Line 800 and Pinkwater Lagoon are manganese (12,792 µg/L—tap water), TNT (174 µg/L—tap water), 2-amino-4,6-DNT (25 µg/L—tap water), 4-amino-2,6-DNT (28 µg/L—tap water), RDX (974 µg/L—tap water), and Freon 113 (39,800 µg/m^3—indoor air; 2,900 µg/L—tap water) in groundwater. No unacceptable risks and hazards were identified for the construction/utility worker; the cumulative risk and target organ HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 800 and Pinkwater Lagoon, given that an interim remedial action is in place that addresses explosives within the lagoon impoundment, and RDX concentrations in surface water collected from Pinkwater Lagoon are much less than the surface water ecological screening values.

IAAP-010G_Line 9 Ammo LAP (Mine) Groundwater (19105.1014)

This area comprises groundwater at the Line 9 Ammo LAP (Mine) (Line 9), which is located in the central portion of the IAAAP facility and encompasses approximately 9 acres; however, the site encompasses over 80 acres (Figure 5.8-1). Soil at Line 9 is addressed under the remedy for OU-1 (IAAP-010) (Leidos, 2018). The site is situated in the Brush Creek watershed and is directly south of the Line 6 Ammo Production site. Former production buildings at Line 9 were removed in 2010 (Bhate, 2011). Line 9 was operated as a percussion component production, storage, and loading facility from 1942 through 1953 and also loaded primer M54 (Tetra Tech, 2006b). Line 9 was closed sometime after 1991 (TN & Associates, 2003b). The site currently falls within the boundary of the active 40-millimeter test range. Historical surface runoff at Line 9 has flowed to ditches and an intermittent tributary of Brush Creek.

The sources of contamination at Line 9 are attributed to the historical processing of explosives, use of volatile organic compounds during site operations, and process wastewater. Explosives and chemicals handled at Line 9 included RDX, TNT, PBX, HMX, pentaerythritol tetranitrate, lead azide, boron potassium nitrate, black powder, sodium thiosulphate, thiosulphate, antimony sulfides, Freon, polychlorinated biphenyls, and various other solvents, paints, and lacquers. Although no spills were recorded at Line 9, historical releases may have occurred at two of the former sumps, which are considered the main source of the Freon 113 plume. Explosives-contaminated water from Line 9 was transported to Line 3A for treatment in carbon columns. Operations at the site ended sometime after 1991.

Based on historical site operations, COCs identified in soil, and a comparison of the most current concentration data (Table 5.8-4) to site characterization PALs and BTVs, explosives, VOCs (including Freon 113), and pentachlorophenol (PCP) were identified as site-related chemicals of interest in groundwater. Explosives and VOCs are consistent with historical site operations. However, no buildings or processes were known to have used PCP. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Freon 113 is the most extensive contaminant and is observed to be present as three shallow groundwater plumes. The plumes are laterally and vertically delineated. On the contrary, PCP exceedances are isolated to one well, JAW-31, and were not observed during the most recent sampling. Iron and manganese concentrations were also elevated in groundwater, but this is associated with the 2005–2006 treatability study, which enhanced reducing conditions in groundwater, and are not site-related.

Line 9 is primarily grass covered, with a few remaining roads that lead to the cleared/paved areas associated with demolished building footprints. Surface drainage is via culverts and several constructed drainage ditches, which are typically shallow on the northern half of the site, increase in depth on the southern half of the site, and remain dry most of the year. The groundwater table at Line 9 is shallow, and groundwater in the overburden aquifer was encountered between 4 and 12 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Given that the overburden aquifer is composed predominantly of clays and the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow, except for in the sand seams present in the aquifer. Freon 113 concentrations in groundwater at Line 9 suggest increasing trends, whereas recent PCP concentrations appear relatively stable or decreasing. Previous investigations suggest that Freon 113 has been potentially present as nonaqueous phase liquid in the saturated zone in borings located at the northeast corner of the conveyor at Building 9-57 and east of the building. This information suggests there may be a continuing source to groundwater. Nevertheless, natural attenuation processes are likely helping to stabilize the plumes, given the very limited extent of the plumes.

The HHRA conducted for Line 9 indicates that the risk and hazard estimates for at least one receptor exceeds EPA's target risk range of 1×10^{-6} to 1×10^{-4} and the hazard index target of 1. Therefore, COCs were identified for exposure scenarios summarized below.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals groundwater at Line 9. The cumulative cancer risk estimate was 8×10^{-4}, and two target organ HI estimates were greater than 1 (NOE and hepatic). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at Line 9 are Freon 113 (6,310,000 µg/m^3—indoor air; 462,456 µg/L – tap water), 1,1-dichloroethene (380 µg/m^3—indoor air; 535 µg/L – tap water), and PCP (6 µg/L – tap water). The HHRA also identified potential unacceptable hazards in groundwater for future site workers and construction/utility workers. The cumulative cancer risk estimate for site workers was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}; one target organ HI (NOE) estimate was greater than 1. The COC, and corresponding exposure point concentration, identified for future site workers at Line 9 is associated with exposure to Freon 113 (6,310,000 µg/m^3—indoor air; 462,456 µg/L—tap water). The cumulative cancer risk estimate for construction/utility workers was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}; one target organ HI (NOE) estimate was greater than 1. The COCs, and corresponding exposure point concentration, identified for future construction/utility workers at Line 9 is associated with exposure to Freon 113 (6,310,000 µg/m^3—trench air). The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 9, given the lack of complete exposure pathways for ecological receptors.

Recommendations

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs at all 8 areas. It is recommended that Feasibility Studies (FSs) be conducted as described below:

- It is recommended that five IAAAP sites (CC-IAAP-001G, IAAP-002G, IAAP-003G, IAAP-006G, and IAAP-010G) remain under OU-6. An FS should be completed for these sites to evaluate remedial alternatives to address the unacceptable risks or hazards from site-related COCs in groundwater.
- It is recommended that one IAAAP site (IAA-004G) be transferred to OU-11, as NFA is warranted for groundwater at this site. NFA will be presented at the preferred remedy in an OU-11 Proposed Plan. This recommendation is based on the fact that site-related chemicals do not pose potential unacceptable risks, hazards, or adverse effects.
- It is recommended that four IAAAP sites (IAAP-016, IAAP-016G, IAAP-044, and IAAP-044G) be transferred to OU-7. An FS should be completed for these sites to evaluate remedial alternatives to address the unacceptable risks or hazards from site-related COCs in multiple media. An interim remedial action is currently in place for both the former Line 1 Impoundment and Pinkwater Lagoon. This interim action is supported by ongoing O&M activities and is effectively addressing soil, sediment, and surface water media at these sites (IAAP-016/IAAP-016G and IAAP-044/IAAP-044G). However, the interim action does not currently fall under an OU. It is recommended that the interim action be presented as the final remedy for these sites and memorialized in a decision document. Because this action will address multiple media and require ongoing O&M, it is recommended that these sites be placed under OU-7. Although the interim actions do not specifically address groundwater at either the former Line 1 Impoundment or Pinkwater Lagoon, it is suggested that

groundwater media (IAAP-016G and IAAP-044G) also be included under OU-7 so that a more comprehensive remedial approach can be developed for these areas.

The recommendations for the 10 IAAAP sites (located within 8 areas) are summarized in Table ES-1:

Table ES-1. Summary of Site Recommendations
Iowa Army Ammunition Plant, Middletown, Iowa

RI Recommendation	HQAES ID	HQAES ID Name (and AEDB Site Number[a])
FS for groundwater under OU-6	19105.1065	CC-001G_Line 1 Groundwater
	19105.1003	IAAP-002G_Line 2 Ammo LAP (Artillery/Shape) Groundwater
	19105.1005	IAAP-003G_Line 3 Ammo LAP (Artillery) Groundwater
	19105.1067	IAAP-006G_Line 5A and 5B Ammo Assembly Groundwater
	19105.1014	IAAP-010G_Line 9 Ammo LAP (Mine) Groundwater
FS for multiple media under OU-7	19105.1021	IAAP-016_Line 1 Former Wastewater Impoundment
	19105.1075	IAAP-016G _Line 1 Former Wastewater Impoundment Groundwater
	19105.1048	IAAP-044_Line 800 and Pinkwater Lagoon
	19105.1049	IAAP-044G_Line 800 and Pinkwater Lagoon Groundwater
NFA for groundwater under OU-11	19105.1007	IAAP-004G_Line 3A Ammo LAP (Artillery) Groundwater

[a] The Army Environmental Database (AEDB) number for each site is the first portion of the HQAES ID name. For example, the AEDB number for Line 2 Ammo LAP (Artillery/Shape) Groundwater is “IAAP-002G.”

HQAES = Headquarters Army Environmental System

Contents

Appendixes

Tables

Figures

Acronyms and Abbreviations

µg	microgram(s)
µg/dL	microgram(s) per deciliter
µg/L	microgram(s) per liter
$\mu g/m^3$	microgram(s) per cubic meter
$(\mu g/m^3)^{-1}$	cubic meter(s) of air per microgram of chemical
ACCLPP	Advisory Committee on Childhood Lead Poisoning Prevention
ADAF	age-dependent adjustment factor
AEDB	Army Environmental Database
amsl	above mean sea level
BEHP	bis(2-ethylhexyl) phthalate
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BLL	blood lead level
BTEX	benzene, toluene, ethylbenzene, and xylenes
BTV	background threshold value
CC	Compliance Cleanup
CCL	Contaminated Clothing Laundry
CEM	conceptual exposure model
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CP	chlorophenol
CSF	cancer slope factor
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
CWWP	*Comprehensive (Brush Creek, Spring Creek, Long Creek, and Skunk River) Watersheds Evaluation and Supplemental Data Collection Work Plan*
DCA	dichloroethane
DCE	dichloroethene
DCP	dichlorophenol
DL	detection limit
DNT	dinitrotoluene

DNX	1,3-dinitroso-5-nitro-1,3,5-triazacyclohexane
DO	dissolved oxygen
DPT	direct-push technology
DRI	Dietary Reference Intake
EC	exposure concentration
ECEM	ecological conceptual exposure model
ELCR	excess lifetime cancer risk
EPC	exposure point concentration
ER,A	Environmental Restoration, Army
ERA	Ecological Risk Assessment
ESV	Ecological Screening Value
EU	exposure unit
FFA	Federal Facility Agreement
ft/ft	foot per foot
FUSRAP	Formerly Utilized Sites Remedial Action Program
GAC	granular activated carbon
GPS	global positioning system
HAL	Health Advisory Level
HHEM	*Human Health Evaluation Manual*
HHRA	Human Health Risk Assessment
HI	hazard index
HMX	hot melt explosive (cyclotetramethylene-tetranitramine)
HQ	hazard quotient
HQAES	Headquarters Army Environmental System
HSA	hollow-stem auger
IAAAP	Iowa Army Ammunition Plant
IAC	Iowa Administrative Code
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic
IRP	Installation Restoration Program
ITR	independent technical review
IUR	inhalation unit risk
K_d	distribution coefficient
kg	kilogram(s)
K_h	Henry’s law constant

K_{oc}	carbon partition coefficient
L	liter(s)
LAP	Load, Assemble, and Pack
LUC	land use control
m^3	cubic meter
MCL	maximum contaminant level
MDC	maximum detected concentration
mg	milligram(s)
mg/kg	milligram(s) per kilogram
mg/kg-day	milligram(s) of chemical per kilogram body weight per day
mm	millimeter
MMOA	mutagenic mode of action
MNX	hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
mV	millivolt(s)
NCED	north-central ephemeral ditch
NFA	No Further Action
NPDES	National Pollutant Discharge Elimination System
NOE	no observable effect
NTCRA	non–time critical removal action
O&M	operation and maintenance
ORP	oxidation-reduction potential
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PAL	project action limit
PARS	PARS Environmental Inc.
PBX	plastic bonded explosive
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
PPRTV	Provisional Peer Reviewed Toxicity Value
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosive
RfC	reference concentration
RfD	reference dose
RG	remedial goal

RI	Remedial Investigation
RL	reporting limit
RME	reasonable maximum exposure
ROD	Record of Decision
RSL	Regional Screening Level
SCED	south-central ephemeral ditch
SL	screening level
SLERA	Screening Level Ecological Risk Assessment
SRI	Supplemental Remedial Investigation
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TCDD	2,3,7,8-tetrachorodibenzodioxin
TCE	trichloroethene
TCP	trichlorophenol
TeCP	tetrachlorophenol
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
TNB	trinitrobenzene
TNT	2,4,6-trinitrotoluene
TNX	trinitroxylene
UCL	upper confidence limit
UFP-QAPP	Uniform Federal Policy–Quality Assurance Project Plan
UTL	upper tolerance limit
VISL	vapor intrusion screening level
VOC	volatile organic compound

SECTION 1

Introduction

This Remedial Investigation (RI) report presents the results of RI activities for 10 environmental sites within 8 areas at the Iowa Army Ammunition Plant (IAAAP), in Middletown, Iowa. IAAAP is an active Joint Munitions Command facility currently operated by civilian contractor American Ordnance, LLC (AO). In accordance with the Federal Facility Agreement (FFA), “site” refers to the IAAAP and any areas contaminated by the migration of hazardous substances from the IAAAP. The term “site” is used to refer to the environmental solid waste management units (SWMUs) and areas of concern at the IAAAP (such as, IAAP-019); this is consistent with Section IX.B of the 2018 Resource Conservation and Recovery Act (RCRA) Permit for the IAAAP.

The eight areas, shown on Figure 1-1, are the following:

- Line 1 Ammo Load, Assemble, and Pack (LAP) (missile/former Atomic Energy Commission) (includes site 19105.1065/CC-IAAP-001G).
- Line 1 Former Wastewater Impoundment (includes sites 19105.1021/IAAP-016 and 19105.1075/IAAP-016G).
- Line 2 Ammo LAP (Artillery/Shape) (includes site 19105.1003/IAAP-002G).
- Line 3 Ammo LAP(Artillery) (includes site 19105.1005/IAAP-003G).
- Line 3A Ammo LAP (Artillery) (includes site 19105.1007/IAAP-004G).
- Lines 5A and 5B Ammo Assembly (includes site 19105.1067/IAAP-006G).
- Line 9 Ammo LAP (Mine) (includes site 19105.1014/IAAP-010G).
- Line 800 and Pinkwater Lagoon (includes sites 19105.1048/IAAP-044 and 19105.1049/IAAP-044G).

The RI was conducted in accordance with the *Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa* (UFP-QAPP) (CH2M, 2017a). This work was completed under two contracts with the U.S. Army Corps of Engineers, Louisville District (USACE): Contract W912QR-12-D-0005, Delivery Order 0006, and Contract Number W912QR21D0019, Delivery Order W912QR21F0421.

1.1 Remedial Investigation Objectives

Several investigations have been conducted at the IAAAP since the 1980s to evaluate the nature and extent of chemicals in site media. The overall objectives of this RI are to update the conceptual site model (CSM) for each site, assess the potential for unacceptable human health risks and hazards and for ecological impacts—that is, identification of chemicals of concern (COCs) or chemicals of ecological concern—and recommend a path forward consistent with the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final* (USEPA, 1988). To meet the objectives, new and previously collected data were evaluated to assess the potential for a contaminant release. The data were used to assess the nature and extent of contamination, evaluate chemical fate and transport, and estimate potential risks and hazards posed by site-related contamination to human health and the environment. The Human Health Risk Assessment (HHRA) approach is discussed in Section 4.3.1, and a detailed assessment is included in Appendix A. The Ecological Risk Assessment (ERA) approach is discussed in Section 4.3.2. The updated CSM was used to recommend whether a Feasibility Study (FS) or a No Further Action (NFA) determination is warranted at each site.

1.2 Installation Background

1.2.1 IAAAP Description

The IAAAP consists of 19,011 acres adjacent to Middletown, in Des Moines County, Iowa. It is approximately 8 miles west of Burlington, and with a population of 25,436, is the largest city in Des Moines County. The installation is bordered by Highway 34 to the north, upland agricultural farms to the east and west, and the Skunk River Valley to the south. The installation layout is shown on Figure 1-1.

The IAAAP is an active Joint Munitions Command facility currently operated by civilian contractor AO. The current mission of the IAAAP is to load, assemble, and pack ammunition items, including projectiles, mortar rounds, warheads, demolition charges, and munitions components such as fuses, primers, and boosters. Approximately one third of the IAAAP property is occupied by active or formerly active production or storage facilities. The IAAAP consists of production lines, landfills, disposal areas, burn areas, a demolition area, and a fire training area. The remaining land is either woodlands or property leased for agricultural usage. The locations of the IAAAP sites are shown on Figure 1-1.

1.2.2 IAAAP Operational History

The principal mission of IAAAP over time has been to load, assemble, and pack operations for a variety of conventional ammunition and fusing systems. IAAAP was constructed in November 1940, as the Iowa Ordnance Plant and started production in 1941. Production was stopped in 1945, when World War II ended. The plant resumed its ammunition manufacturing mission in 1949, prior to the Korean War. In 1950, in response to the Korean conflict, production increased dramatically. From 1947 through mid-1975, the former Atomic Energy Commission occupied facilities on the site for nuclear weapons and non-nuclear additional weapon-assembly operations; those facilities then reverted to Army control in 1975 (H&S Environmental, 2016).

The IAAAP has a National Pollutant Discharge Elimination System (NPDES) permit in place (Permit 2900900) as part of its operations. In 1995, permitted outfalls were reported at Lines 1, 2, 3, 5, and 800, which discharged to Brush Creek, and at Line 3A, which discharged to the Skunk River. At that time, combined Royal Demolition Explosive (RDX) plus hot melt explosive (HMX) discharge concentrations were as great as 1,410 micrograms per liter (µg/L), and 2,4,6-trinitrotoluene (TNT) discharge concentrations were as great as 2,540 µg/L (JAYCOR, 1996).

The 2001 permit allowed discharge of effluent with explosives (TNT and RDX + HMX) from 11 outfalls at the facility. The permit was updated in 2020 and currently allows for seven outfalls to discharge effluent with explosives with a 30-day average of 0.75 milligrams per liter (mg/L) and daily maximum discharge of 2.25 mg/L for RDX + HMX, and with a 30-day average of 0.33 mg/L and daily maximum discharge of 1.00 mg/L for TNT (Figure 1-2). Five outfalls included on the updated permit do not include explosives.

1.2.3 IAAAP Regulatory Setting

Due to explosives-contaminated surface water leaving the installation boundaries, the IAAAP was added to the National Priorities List in August 1990. In September 1990, a FFA was signed by U.S. Environmental Protection Agency (USEPA) Region 7 and the U.S. Army; it became effective in December 1990. The 1990 FFA identified 30 RCRA SWMUs at the facility. The 2018 RCRA Permit (USEPA, 2018a) stated that the SWMUs listed in the 1990 FFA are being integrated into the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) sites; the integration plan is currently being developed. Through the FFA, the U.S. Army works with USEPA, with support provided by Iowa Department of Natural Resources (IDNR). The IAAAP was placed under the U.S. Department of Defense (DoD) Installation Restoration Program (IRP), which follows the CERCLA process, as amended by the Superfund Amendments and Reauthorization Act.

In July 2002, several areas of the IAAAP previously used by the former Atomic Energy Commission were designated by USACE to be under the Formerly Utilized Sites Remedial Action Program (FUSRAP) and therefore were subsequently removed from the DoD IRP (U.S. Army, 2007). Investigations continued at the FUSRAP areas, and an additional FFA for FUSRAP was finalized in August 2006 (USACE, 2011a).

The IAAAP is currently divided into eight operable units (OUs) (USACE, 2016):

- OU-1 (soils): soil on the IAAAP other than those contaminated by use or testing of military munitions or by radiological chemicals.
- OU-3 (offsite groundwater): groundwater outside of the IAAAP boundary.
- OU-4 (Inert Disposal Area): the Inert Disposal Area and its associated landfills, trenches, and sedimentation ponds.
- OU-5 (Military Munitions Response Program): Military Munitions Response Program sites.
- OU-6 (onsite groundwater): groundwater within the IAAAP boundary.
- OU-7 (Installation-wide): miscellaneous IAAAP sites not included in the other OUs.
- OU-8 (FUSRAP): sites contaminated by radiological and other contaminants by former Atomic Energy Commission activities and now being addressed by FUSRAP.
- OU-9 (Construction Debris Areas): construction debris disposal sites.

OU-2 was also established originally for soil removal actions but was subsequently merged into OU-1. OU-4 was originally considered the installation-wide OU; however, in October 2009, the previously unaddressed areas of soil contamination were placed in OU-7, and the Inert Disposal Area remained in OU-4 (Tetra Tech, 2011a). Because RCRA Compliance Cleanup (CC) sites were managed under RCRA, they do not currently fall within an OU.

Several of the sites at the IAAAP have been investigated under more than one OU, the FUSRAP program, or the CC program. To streamline the CERCLA process, three new OU divisions (OU-10, OU-11, and OU-12) are being proposed based on recommended remedial actions for the IAAAP sites. The OU-10 grouping is proposed for IAAAP groundwater sites in the Explosives Disposal Area. The OU-11 grouping is proposed for miscellaneous IAAAP sites that warrant an NFA decision. The OU-12 grouping is proposed for IAAAP sites that were formally managed under the CC program.

1.2.4 IAAAP Sites Included in This Report

The Headquarters Army Environmental System (HQAES) includes 75 IRP sites at the IAAAP. Originally, only the 30 SWMUs that were identified in the FFA were included (IAAP-001 through IAAP-030). The U.S. Army Toxic and Hazardous Material Agency's draft final *Potential Areas of Concern Supplement* (USATHAMA, 1991) identified IAAAP sites IAAP-031 through IAAP-043. Between 1999 and 2003, IAAAP sites IAAP-044 through IAAP-047 were added to address Pinkwater Lagoon, the former fuel station underground storage tanks, off-installation groundwater, and the Central Test Area. In addition, in 2002, nine groundwater-designated sites, or "G" sites, were created to facilitate management of groundwater at areas known to have groundwater contamination (such as Line 2). To further separate and manage IAAAP areas by OU, 24 additional IRP sites with a "G" designation were created in the Army database in 2012.

The 10 IAAAP sites within 8 areas included in this RI report are summarized in Table 1-1. The table lists the HQAES identification (ID) numbers and names, a brief site description, the OU that the IAAAP site is currently associated with, and the RI report section where the IAAAP site is discussed in more detail. The table also provides information regarding the Army Environmental Database (AEDB) number for each site.

Table 1-1. IAAAP Sites Included in OU-6 RI Report

IAAAP Area (Abbreviation for RI Report)	HQAES ID	HQAES ID Name (and AEDB Site Number[a])	Current OU	Media Addressed in RI Report	Brief Site Description	RI Report Section
Line 1 Ammo LAP (missile/former Atomic Energy Commission) (Line 1)	19105.1065	CC-001G_Line 1 Groundwater	OU-6	Groundwater	Encompasses 231 acres and is located in the northeastern quadrant of the IAAAP facility.	5.1
Line 1 Former Wastewater Impoundment (Line 1 Impoundment)	19105.1021	IAAP-016_Line 1 Former Wastewater Impoundment	Unassigned	Soil, surface water, and sediment	Located southwest of Line 1 and includes a former wastewater impoundment pond that is approximately 1,300 feet long and parallels Brush Creek.	5.2
	19105.1075	IAAP-016G _Line 1 Former Wastewater Impoundment Groundwater	OU-6	Groundwater		
Line 2 Ammo LAP (Artillery/Shape) (Line 2)	19105.1003	IAAP-002G_Line 2 Ammo LAP (Artillery/Shape) Groundwater	OU-6	Groundwater	Encompasses a 140-acre active site in the north-central portion of the IAAAP facility, located south of Line 1.	5.3
Line 3 Ammo LAP(Artillery) (Line 3)	19105.1005	IAAP-003G_Line 3 Ammo LAP (Artillery) Groundwater	OU-6	Groundwater	Encompasses a 149-acre active site in the central portion of IAAAP facility, located between Lines 9, 6, and 7 and Brush Creek.	5.4
Line 3A Ammo LAP (Artillery) (Line 3A)	19105.1007	IAAP-004G_Line 3A Ammo LAP (Artillery) Groundwater	OU-6	Groundwater	Encompasses a 119-acre active site located in the southwestern quadrant of the IAAAP facility.	5.5
Lines 5A and 5B Ammo Assembly (Lines 5A/5B)	19105.1067	IAAP-006G_Line 5A and 5B Ammo Assembly Groundwater	OU-6	Groundwater	Located in the north-central portion of the IAAAP and are bounded by Yard L to the north, Line 1 to the east, Lines 4A and 4B to the south, and Yard J to the west. Line 5A encompasses approximately 33 acres in the Brush Creek watershed and Line 5B encompasses approximately 41 acres in the Long Creek watershed, west of Line 5A.	5.6

Table 1-1. IAAAP Sites Included in OU-6 RI Report

IAAAP Area (Abbreviation for RI Report)	HQAES ID	HQAES ID Name (and AEDB Site Number[a])	Current OU	Media Addressed in RI Report	Brief Site Description	RI Report Section
Line 800 and Pinkwater Lagoon	19105.1048	IAAP-044_Line 800 and Pinkwater Lagoon	Unassigned	Soil, surface water, and sediment	Encompasses approximately 18 acres in the central part of the IAAAP facility.	5.7
	19105.1049	IAAP-044G_Line 800 and Pinkwater Lagoon Groundwater	OU-6	Groundwater		
Line 9 Ammo LAP (Mine) (Line 9)	19105.1014	IAAP-010G_Line 9 Ammo LAP (Mine) Groundwater	OU-6	Groundwater	Located in the central portion of the IAAAP facility and encompasses approximately 9 acres; however, the site boundary encompasses over 80 acres.	5.8

[a] The AEDB number for each site is the first portion of the HQAES ID name. For example, the AEDB number for Line 2 Ammo LAP (Artillery/Shape) Groundwater is “IAAP-002G.”

IAAAP Environmental Setting

2.1 Climate

Des Moines County has a typical Midwestern climate of hot/humid summers and cold/wet winters. According to the National Weather Service (2020), between 1981 and 2010, the mean annual temperature in this area was 53 degrees Fahrenheit. The average annual precipitation in this area is 38.48 inches. During winter, precipitation frequently occurs as snow, and during the rest of the year it is mainly rain, often heavy. The greatest rainfall amounts tend to occur between May and August. Snowmelt during spring, combined with frozen or saturated soil conditions that reduce infiltration, can result in a large volume of runoff and substantial erosion. In addition, severe thunderstorms in summer can also result in a large volume of precipitation over a short period of time and create large runoff volumes (H&S Environmental, 2016).

2.2 Topography

IAAAP is in the Southern Iowa Drift Plain. The highest elevation in the county, 862 feet above mean sea level (amsl), is located about 13 miles north of IAAAP, near the town of Yarmouth, Iowa. The lowest elevation, about 520 feet amsl, is located where the Skunk River enters the Mississippi River at the southeastern boundary of the county. Vertical reliefs between lowlands and adjoining uplands generally range from 50 to 120 feet.

Where it is not dissected by drainages, the topography at IAAAP is generally flat in the uplands and slopes gently toward the south. Elevations at IAAAP range from 732 feet amsl along the northern extent of the installation to about 544 feet amsl throughout the extensive southern area of Long Creek and Skunk River.

2.3 Surface Water Hydrology

The IAAAP contains five different hydrologic watersheds: Brush Creek, Little Flint Creek, Long Creek, Skunk River, and Spring Creek (Figure 2-1). A watershed is an area of land that drains to a common water outlet, such as a creek or ocean. These four creeks and Skunk River are the common water outlets, or water features to which a watershed drains, present at IAAAP. A watershed includes all the surface water (that is, lakes, reservoirs, and wetlands) within the defined land area. Surface water does not cross watershed boundaries. That is, surface water in drainages in the Brush Creek watershed will not flow into the Long Creek watershed (Figure 2-1). Groundwater in the overburden aquifer (Figure 2-2) and bedrock aquifer (Figure 2-3) are also influenced by the watershed boundaries; however, where the aquifer is deeply confined, groundwater is likely to ultimately discharge to a larger watershed, such as a large river, rather than to a small tributary. At the IAAAP, the Brush Creek and the Long Creek watersheds drain most of the installation.

The five watersheds are summarized as follows:

- The Brush Creek watershed is in the east-central portion of the IAAAP and is fed by intermittent tributaries. Water that drains into Brush Creek flows generally south and exits at the southeastern boundary of the IAAAP. Approximately 3 miles beyond the IAAAP, the creek flows into the Skunk River (Tetra Tech, 2006b).

- The Little Flint Creek watershed comprises a very small area in the north-central portion of the facility. Water that drains into this watershed flows northward, away from the installation, before turning south again and joining the Spring Creek watershed (Tetra Tech, 2006b).
- The Long Creek watershed is in the west-central portion of the IAAAP and is fed by unnamed perennial tributaries from the north and many small intermittent tributaries (Tetra Tech, 2006b). Long Creek has been dammed to form George H. Mathes Lake, within the central area of the IAAAP. Water that drains into Long Creek generally flows east-southeast and south and exits at the southeastern boundary of the installation. Approximately half a mile beyond the IAAAP, the creek flows into the Skunk River (Tetra Tech, 2006b).
- The Spring Creek watershed is in the eastern portion of the IAAAP and is fed by perennial tributaries from the north and east and several smaller intermittent tributaries (Tetra Tech, 2006b). Water that drains into Spring Creek generally flows south and exits at the southeastern boundary of the IAAAP. The creek eventually discharges into the Mississippi River.
- The Skunk River watershed is in the southwest corner of the IAAAP and is primarily fed by small intermittent tributaries (Tetra Tech, 2006b). This watershed drains to Skunk River, which is just outside the southwest boundary of the IAAAP. The river then flows generally east-southeast.

Streamflow can fluctuate over any given year due to many factors. The amount of precipitation varies seasonally, as described in Subsection 2.1. Snow typically stays where it falls, and therefore streamflow may decrease during this period. However, if the ground is frozen when the snow melts, then runoff to the streams may increase temporarily because water cannot infiltrate into the ground. When evapotranspiration is high, as in the early spring or summer, streamflow can decrease because more water is being taken up by plants and released to the atmosphere. Streamflow is also impacted by seasonal fluctuations in the water table elevation of the surficial groundwater aquifer.

The creeks at the IAAAP have been observed to be "gaining" and "losing" streams. A gaining stream is one that gains water from groundwater, typically because the stream channel bottom is lower than the groundwater table. Therefore, groundwater will discharge to the water body. In contrast, a losing stream is one that loses water to groundwater. It is common for a creek to be a gaining stream in one area and a losing stream in another area. Also, creeks and rivers may be gaining at one time of the year and losing in another time of the year.

2.4 Soil

With exception of developing soil associated with rivers and drainages, soil on IAAAP belongs to either the Mollisols or Alfilsols soil orders. Mollisols are a relatively fertile soil and are characterized by a soft surface character, a high base saturation (generally indicative of fertile soil), and a dark color due to abundant humus. Alfilsols are also a relatively fertile soil with moderate to high base saturation. Agriculture plays a major role in Des Moines County, with almost 56 percent of the county designated as prime farmland.

2.5 Geology

IAAAP is in the Dissected Till Plain section of the Central Lowland Physiographic Province of the Southern Iowa Drift Plain Landform Region. The facility is underlain by a sequence of unconsolidated glacial deposits of Pleistocene age (collectively known as overburden) overlying sedimentary bedrock units.

The overburden deposits near IAAAP include alluvium, loess, and glacial drift (including glacial till). The alluvium is composed of alluvial sediment (medium-to-fine-grained sandy silt with varying proportions of gravel) that was deposited in the stream valleys via water flow. Within the IAAAP, alluvium is typically present only near creeks, the Skunk River, and associated tributaries.

Loess, identified as the Peoria Loess near IAAAP, is windblown material composed principally of silt with small amounts of sand and clay and is the basis for the development of fertile soil. The loess was deposited during interglacial periods over the glacial drift. It is found throughout the state, including the plant. The glacial drift consists primarily of silty clay and clayey silt with thin sand seams and lenses and are assigned to the Kellersville Till Member (Illinoian Age) of the Glasford Formation of southeastern Iowa. Figure 2-4 presents a conceptual stratigraphic column for Iowa.

The glacial till extends to depths more than 100 feet below ground surface (bgs) in portions of the northern half of IAAAP, but it is thin or absent locally in deeper stream valleys in the south around Mathes Lake and in the northeast. In general, the glacial till is thicker in the upper reaches, especially in the Brush Creek watershed, and thins to the middle reaches. The till remains relatively constant in thickness in the Long Creek and Spring Creek watersheds.

The bedrock underlying IAAAP consists of a sequence of limestones interbedded with varying thicknesses of shales and sandstones ranging in age from Cambrian to Mississippian. The uppermost rock units within the area are the Warsaw Shale, the Keokuk Limestone, and the Burlington Limestone. There are two basic formations of importance at the facility, which are the uppermost rock units within the area, the Keokuk Limestone and Burlington Limestone of the Osage Series (Mississippian).

Geologic information collected at the individual IAAAP sites is summarized in Section 4. Conceptual cross sections were developed using soil boring log information across the facility. Figures 2-5, 2-6, and 2-7 are simplified geologic cross sections showing the distribution of the geologic layers at IAAAP.

2.6 Hydrogeology and Aquifer Properties

Des Moines County has four principal aquifers: the surficial (overburden) aquifer and the bedrock aquifers of Mississippian, Devonian, and Cambro-Ordovician units. The aquifers of concern for this RI at the IAAAP are the overburden aquifer and the youngest bedrock (Mississippian) aquifer. Figure 2-8 summarizes the hydrogeologic units in Des Moines Iowa. Site-specific discussions of the hydrogeologic aquifers, including depths to groundwater and localized flow patterns, are summarized in Section 4.

Consistent with regional hydrogeologic maps (Coble, 1971), the overburden aquifer is composed predominantly of the unconsolidated glacial drift (Kellersville Till) in the upland, northern portion of the IAAAP and of the alluvium within the lower creek and river valleys in the southern portion of the IAAAP (Figure 2-9). The overburden aquifer typically does not include the loess; however, groundwater may exist at the loess–till geologic contact. In these cases, water migrates vertically through the loess. Upon reaching the till, it may "spread" out horizontally within the loess layer, because the permeability of the till is typically much less than that of the loess. Therefore, vertical flow into the glacial till is restricted. This may also create perched water conditions. Because of the general low permeability of the glacial till, it may act like a confining layer within the surficial aquifer (IDNR 2003). However, because the till includes beds of sand and gravel, more-permeable zones can be found within the aquifer. These sand beds, which are the result of episodes of meltwater during the glacial periods, are generally thin and discontinuous lenses. In contrast, in areas where the overburden aquifer exists primarily within the alluvium, the aquifer may yield moderate or high volumes of water. These aquifers are generally confined to stream valleys. Groundwater flow direction in the overburden aquifer typically mimics surface topography, with flow in southeasterly or southwesterly toward Brush Creek, Long Creek, Spring Creek, and the Skunk River (Figure 2-2).

Groundwater flow within the bedrock aquifers occurs primarily within secondary permeability zones, including fractures, joints, and bedding planes. Overall flow direction is to the south and east toward the Skunk and Mississippi Rivers, when not intercepted by incised surface drainages (Figure 2-3). The bedrock aquifers are separated by aquicludes, which are low-permeability geologic units that act as confining units and restrict groundwater flow between the aquifers. The Devonian and Cambro-

Ordovician bedrock aquifers formations form the principal water-bearing zone near the IAAAP and occur at a depth of approximately 1,500 feet bgs (JAYCOR, 1996). Water in these aquifers is reported to be highly mineralized and objectionably hard and contains large amounts of total dissolved solids.

Aquifer hydraulic conductivity (slug) testing has been performed at over 100 wells at the IAAAP, as part of previous investigations conducted between 1981 and 2003. Previous investigations at the individual IAAAP sites are summarized in Section 4. For wells screened in till and till combinations (such as fill and till, loess and till, or alluvium and till), hydraulic conductivity values ranged from 0.00035 foot/day to 4.3 feet/day, with an average of 0.64 foot/day. The greater range of values is indicative of wells screened within sandier layers, whereas the lesser range of values is indicative of wells screened predominantly within clay. For wells screened in bedrock and bedrock combinations (bedrock and till and bedrock and till/glacial outwash), hydraulic conductivity values ranged from 0.00015 foot/day to 51 feet/day, with an average of 2.3 feet/day. Slug test results are generally considered to represent an order-of-magnitude level of precision and accuracy in estimating horizontal hydraulic conductivity.

In areas where the overburden aquifer exists primarily within the glacial till, the aquifer typically has a very low yield (less than 10 gallons per minute; Figure 2-8). In comparison, aquifer yields within alluvium aquifers may yield 25 to 100 gallons per minute.

2.7 Ecology

Wildlife found in available habitats at IAAAP includes a large white-tail deer population, fox, gray squirrel, raccoon, woodchuck, coyote, eastern cottontail rabbit, mouse, mole, pocket gopher, beaver, muskrat, badger, opossum, and mink. To effectively manage the overpopulation of deer, limited recreational hunting has been allowed onsite. Recreational trapping of fur-bearing mammals is also allowed during limited times of the year (USACE, 2019a).

Numerous bird species inhabit or migrate through the IAAAP. Some of the most common species include the American robin, northern cardinal, blue jay, red-headed woodpecker, common crow, common grackle, mourning dove, red-winged blackbird, chipping sparrow, eastern meadowlark, American goldfinch, and turkey. The red-headed woodpecker is protected under the Migratory Bird Treaty Act of 1918 (16 U.S. Code 703-712), which is administered by the U.S. Fish and Wildlife Service. Red-tailed hawks are the most common raptor species present, but bald eagles have been observed flying over the IAAAP or feeding on the fish they catch in Mathes Lake (H&S Environmental, 2016).

The U.S. Fish and Wildlife Service provided maintenance stocking of walleye and striped bass hybrids in Mathes Lake to predate on the abundant gizzard shad (*Dorosoma cepedianum*). Channel catfish are generally stocked in new impoundments or to supplement natural reproduction. Some natural channel catfish reproduction in Mathes Lake has been noted (H&S Environmental, 2016).

Federally listed threatened or endangered species that have been recorded on the IAAAP property include the Indiana bat (*Myotis sodalis*) and the northern long-eared bat (*Myotis septentrionalis*). The northern long-eared bat is listed as threatened throughout Iowa (USFWS, 2018a). The Indiana bat is listed as endangered in a number of counties in Iowa including Des Moines. Based on information presented by the U.S. Fish and Wildlife Service (USFWS) (USFWS, 2018b), these species are fairly similar in ecology and life history. For example, USFWS (2018b) notes that "the northern long-eared bat and Indiana bat are both temperate, insectivorous, migratory bats that hibernate in mines and caves in the winter and spend summers in wooded areas." Both species typically hibernate mid-fall through mid-spring each year. Suitable summer habitats for both species include a wide variety of forested/wooded habitats where they roost, forage, and travel. Some adjacent and interspersed nonforested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures could occur in the forested habitats. The main habitat difference between the two bats appears to be that northern long-eared bats are typically associated with upland forests with generally more canopy cover than are

Indiana bats. Northern long-eared bats prefer upland, mature forests (Caceres and Pybus, 1997) with occasional foraging over forest clearings, water, and along roads (Jong, 1985). However, most foraging occurs on forested hillsides and ridges rather than along riparian areas preferred by the Indiana bat (Brack and Whitaker, 2001; LaVal et al., 1977).

In 1999, a National Wetlands Inventory was conducted on the installation by the U.S. Fish and Wildlife Service. Based on the inventory, IAAAP contains 113.2 acres of wetland. Forested wetlands are the dominant type, representing about 50 percent of the installation's wetlands. The next most common type is unconsolidated bottoms ("ponds"), which comprise about 24 percent of the wetlands. IAAAP contains 57.3 miles of linear wetlands including rivers and streams (3.1 miles of wetlands and 54.2 miles of rivers and streams). Wetland acreages are as follows: Emergent Wetland—14.7 acres; Scrub/Shrub Wetland (Broadleaved Deciduous)—10.8 acres; Forested Wetland—60.2 acres (Temporarily Flooded—56.5 acres and Seasonally Flooded—3.7 acres); and Unconsolidated Bottom—27.5 acres (H&S Environmental, 2016).

2.8 Land and Resource Use

The current mission of the IAAAP is to load, assemble, and pack ammunition items. Public access to the installation is restricted by perimeter fencing and the IAAAP installation security staff. Approximately 8,000 acres of the IAAAP are leased for agricultural use, 7,500 acres are forested, and the remaining areas are used for administrative and industrial operations (USACE, 2016). Recreational facilities are located on the IAAAP property and in the area immediately surrounding the IAAAP. Hunting and fishing are regulated at the IAAAP using permits. There is also a boat ramp on the eastern shore of Mathes Lake. Currently, portions of Mathes Lake are used for recreational purposes by employees and the public.

Future residential use is not anticipated for IAAAP. The anticipated future land uses at the IAAAP are commercial, industrial, agricultural, and recreational (USACE and Dawson Solutions, 2021). Iowa Army Ammunition Plant has been divided into three planning districts by stakeholders in IAAAP's *Vision Plan* (Pond & Company, 2017): Industrial Core District, Logistics/Storage District, and Agricultural/Natural Resources District. The Industrial Core District encompasses the centrally located production and testing areas, along with production Line 3A, Burning Grounds, and the Demolition Area. The Logistics/Storage District is composed of nine separate subdistricts throughout the plant that house all inert storage, explosive storage, and shipping and receiving functions. The land area that remains, largely undeveloped or leased to outside agriculture companies, was designated as the Agriculture/Natural Resources District (Pond & Company, 2017). The final *Explanation of Significant Differences for the Records of Decision Soils Operable Unit 1 (OU-1)* (Leidos, 2018) establishes the requirements for land use controls (LUCs) for OU-1 areas and the excavation areas associated with the non–time critical sump removal actions. LUCs will include (Leidos, 2018):

> prohibitions on land use (e.g., through incorporation of a formal institutional control) to maintain commercial/industrial (i.e., nonresidential), to prohibit residential land use, and to prohibit the development and use of the property for elementary and secondary schools, child care facilities and playgrounds.

Per the Record of Decision (ROD) for OU-5 (CB&I, 2014), LUCs have also been established as the remedy for Military Munitions Response Program areas. The LUCs for OU-5 consist of access restrictions (such as fencing and signage).

The land surrounding the IAAAP is characterized as rural and is expected to remain rural (USACE, 2016). The largest population centers are the towns of Burlington, West Burlington, Middletown, and Danville (U.S. Census Bureau, 2010). Near OU-3, the land use is predominantly rural, residential, and agricultural, and used mostly for corn and soybean production (USACE, 2016). Some of the farmland is reclaimed floodplain, meaning it has been elevated with drain tiles to control the water table. Some of the floodplain is owned by a commercial sand and gravel quarry which has recently expanded their land holdings into the contaminant plume extent. Other than the extension westward of the quarry, no significant change in future land use is known or anticipated (USACE, 2016). In 1994, all residences south of the IAAAP, east of an unnamed tributary of Skunk River that flows from the Line 3A area, and west of Spring Creek were offered connection to the Rathbun public water supply. Most of the residences were connected to the Rathbun public water supply as authorized by the 1993 action memorandum (Department of the Army, 1993); however, some residences declined or did not respond to the Army's 1993 offer. Groundwater is used for residential potable supply except where connections to the Rathbun Regional Water Supply have been made. Groundwater in this off-facility area is addressed under the OU-3 remedy.

Since 1977, IAAAP has received potable drinking water on a fee basis from the Burlington Regional Water Works in the town of Burlington. Burlington's water source is the Mississippi River. The Burlington Regional Water Works pumps water from their treatment plant to the City of Burlington's distribution center. Groundwater use on the installation has been discontinued, and known production wells have been closed, including four deep groundwater wells that were closed in the early to mid-1990s. There are two exceptions: F-Yard Well 500-165-6, where groundwater from the IAAAP is used in cyclic heating of poured ammunition rounds, and D-Yard Well 500-165-5, from which groundwater supplies the restroom at Yard D (Busard, pers. comm., 2019).

SECTION 3

RI Field Investigation Activities

This section describes the methodology of the field investigation activities conducted as part of the current RI at IAAAP for the sites included in this report. Field activities were performed at Line 1, Line 1 Impoundment, Line 2, Line 3, Line 3A, Lines 5A/5B, Line 9, and Line 800 and Pinkwater Lagoon from 2018 through 2020 to address data gaps identified in the final UFP-QAPP that hindered completion of the RI at these IAAAP sites. Previous investigations for these IAAAP sites are described in Section 5. The field activities conducted during this RI consisted of the following activities:

- Site preparation/mobilization.
- Utility clearance.
- Outfall evaluation.
- Soil sampling.
- Monitoring well installation, development, and sampling.
- Temporary well installation and sampling.
- Surveying.
- Decontamination.
- Waste management.
- Data management.

Samples collected during the RI field investigation were submitted to preapproved, offsite laboratories (Test America Laboratory in Arvada, Colorado; Savanna, Georgia; and St. Louis, Missouri; and Eurofins Laboratory in Lancaster, Pennsylvania).

This section provides an overview of the RI field activities. Section 5 provides specific investigation objectives and RI field investigations for individual IAAAP sites. Appendix B contains laboratory reports and the data quality evaluation. Appendix C contains the field documentation, Appendix D contains the waste management documentation, and Appendix E contains the survey data as applicable to the 2018–2020 RI monitoring well installation activities.

3.1 Site Preparation/Mobilization

3.1.1 Permits/Base Access

Fieldwork was coordinated with USACE and appropriate installation points of contact, including AO, the onsite contractor at the IAAAP. Work clearances and permits were obtained for all field activities. Laydown areas for equipment storage and staging were made available and determined through coordination with AO points of contact.

CH2M team field personnel obtained construction identification badges from AO Security prior to conducting field activities. CH2M team personnel obtained camera passes from AO Security. Well keys were signed out and returned daily at AO Security.

3.1.2 Biological/Ecological Survey

Prior to intrusive activities and any vegetation removal, an Iowa Department of Natural Resources–approved biologist walked each of these sites to inspect and eliminate potential impacts to federally protected species, including the Indiana bat (*Myotis sodalist).* All intrusive work was coordinated with base Natural Resources manager and conducted within permitted months.

3.1.3 Vegetation Removal

Because many of the proposed sampling locations were in heavily vegetated areas, clearance was required to allow site access. Vegetation clearance was performed by Allworth Contracting (Allworth) or PARS Environmental Inc. (PARS) using both mechanical and manual methods. Allworth or PARS field personnel cut vegetation consisting of grass, shrubs, brush, and small trees. The paths and work areas were maintained, as needed, by PARS for the duration of the investigation.

3.1.4 Utility Survey

Prior to the start of any intrusive work, CH2M identified and marked sampling locations and coordinated activities with the AO representatives. In addition, the Underground Detective was contracted by CH2M to perform third-party utility location activities at offsite locations. AO completed third-party utility clearance prior to all intrusive activities at the IAAAP. In addition to the utility location activities, all proposed intrusive drilling locations were cleared to check for buried utilities using hand augers to a depth of at least 5 feet bgs.

3.1.5 Outfall Evaluation

Based on the 2011 NPDES permit, outfalls that were used for discharge of effluent with explosives were previously located at Line 1, Line 2, Line 3, Line3A, Lines 5A/5B, and Line 800. The 2020 NPDES permit identified outfalls for explosives effluent discharges only at Line 2, Line 3, Line 3A, Line 3A Sewage Treatment Plant, and the Sewage Treatment Plant (Figure 1-2).Because some of the outfalls from the 2001 permit were located in heavily wooded areas or in areas where buildings have been demolished, a field reconnaissance action was conducted to verify the locations and observe whether surface water was present at the outfall locations.

Outfall locations were not accessible at Line 2, but locations at the remaining sites were assessed in April 2019, and no surface water was present during the inspection. Therefore, no samples were warranted from this outfall investigation.

3.2 Remedial Investigation Methods

Additional field work was conducted at the IAAAP sites below to resolve data gaps needed to complete the RI, per the final UFP-QAPP. The following field activities were conducted in 2018 through 2020:

- Line 1—monitoring well installation, well development, water-level gauging, slug testing, groundwater sampling, surveying, and waste management.
- Line 1 Impoundment—water-level gauging, slug testing, groundwater sampling, surveying, and waste management.
- Line 2—monitoring well installation, well development, water-level gauging, groundwater sampling, surveying, and waste management.
- Line 3—temporary well installation, water-level gauging, groundwater sampling, surveying, and waste management.
- Line 3A—temporary well installation, monitoring well installation, well development, water-level gauging, groundwater sampling, surveying, and waste management.
- Lines 5A/5B—temporary well installation, monitoring well installation, well development, water-level gauging, groundwater sampling, surveying, and waste management.

- Line 9—water-level gauging, groundwater sampling, surveying, and waste management.
- Line 800 and Pinkwater Lagoon—monitoring well installation, well development, water-level gauging, groundwater sampling, surveying, and waste management.

This section describes the field methods that were implemented. Site-specific details, including the selected sampling or well installation methods, are provided in Section 5.

3.2.1 Soil Sampling

Surface soil samples were collected using hand tools (i.e., spade, scoop, or auger). Soil samples were logged in accordance with the Unified Soil Classification System in accordance with ASTM International standard D2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)." Appendix C contains the soil borings logs.

Soil samples were collected in laboratory-prepared sampling containers that were pre-preserved based on the analytical method and submitted to Test America or Eurofins.

See Section 5 for details on soil sampling activities completed at the IAAAP sites in this RI report.

3.2.2 Direct-push Technology Groundwater Sampling

Discrete groundwater samples were collected using direct-push technology (DPT) drilling methods. Continuous soil samples were collected, as required, using 4- to 5-foot-long acetate sleeves to log the soil lithology. Grain size, color, moisture content, consistency, and other observations such as evidence of contamination were recorded. Appendix C contains the soil boring logs. Discrete groundwater samples were collected with a screen point sampler or equivalent. The sample intervals were identified based on site-specific geological conditions, as described in Section 5. Once the borehole was advanced using DPT drilling methods to the desired depth, the rods were retracted to expose the screen point sampler and allow groundwater to infiltrate the rods. Groundwater samples were then collected using a peristaltic pump in accordance with methods described in Section 3.2.7. Following sampling, boreholes were abandoned in accordance with State of Iowa requirements, unless specified otherwise in Section 5. At boreholes located in concrete or asphalt, the top 6 inches were patched to match the existing ground surface. See Section 5 for details on DPT discrete groundwater samples collected at the IAAAP sites in this RI report.

3.2.3 Temporary Well Installation

Temporary wells were installed using DPT, hollow-stem auger (HSA), rotosonic, or downhole hammer drilling methods. Continuous soil samples were collected using 4- to 5-foot-long acetate sleeves to log the soil lithology, unless mentioned otherwise in Section 5. Grain size, color, moisture content, consistency, and other observations such as evidence of contamination were recorded. Appendix C contains the soil boring logs. The temporary wells were constructed through the drill rods with a 1- or 2-inch-diameter polyvinyl chloride (PVC) riser and a 0.010-inch slotted, 1- or 2-inch-diameter PVC screen. Screen lengths were selected to straddle the targeted saturated zone. A silica sand filter pack was placed around the annular space of the well screen from the bottom of the boring to 2 feet above the well screen. Bentonite chips were then placed above the filter pack to the ground surface and hydrated to complete the temporary wells. After the wells were set, the rods were removed, leaving only the temporary well and disposable end points in the ground.

Following sampling, the temporary wells were abandoned in accordance with State of Iowa requirements. At locations located in concrete or asphalt, the top 6 inches were patched to match the existing ground surface. See Section 5 for details on temporary wells installed at the IAAAP sites in this RI report.

3.2.4 Permanent Monitoring Well Installation

The permanent monitoring wells were installed in accordance with the final UFP-QAPP (CH2M, 2017a) using DPT, HSA, downhole hammer, or rotosonic drilling methods. During drilling, continuous soil samples were collected to log the soil lithology. Grain size, color, moisture content, consistency, and other observations such as evidence of contamination were recorded. Appendix C contains the soil boring logs.

New monitoring wells were constructed with a 2-inch-inside-diameter Schedule 40 PVC screen and a riser with a 0.010-inch slot size screen. A silica sand filter pack was placed around the annular space of the well screen from the bottom of the boring and well screen to a depth of about 2 feet above the top of the screen. A bentonite layer roughly 2 feet thick was placed at the top of the sand pack. After the bentonite was allowed to hydrate, a cement-bentonite grout was placed in the remaining annular space to the surface. The monitoring wells were completed flush to ground surface with a traffic-rated, watertight, steel vault, and locking watertight cap. Appendix D contains the well construction diagrams. See Section 5 for details on permanent monitoring wells installed at the IAAAP sites in this RI report.

3.2.5 Monitoring Well Development

New monitoring wells were developed at least 24 hours after installation was completed to remove fine-grained sediment generated during construction. Monitoring wells were developed by a combination of bailing, surging, and pumping. Well development continued until water quality parameter readings stabilized with three consecutive readings, in accordance with the final UFP-QAPP (CH2M, 2017a), unless otherwise mentioned in Section 5. Well development information, including water quality data and the volume of groundwater removed, was recorded on a well development log or in the field logbook. Appendix C contains the well development logs. See Section 5 for details on well development activities at the IAAAP sites in this RI report.

3.2.6 Water-level Survey

Manual groundwater elevation measurements were obtained from monitoring wells using an electronic water-level meter with 0.01-foot graduations. The depth to water in each well was measured from a designated point on top of the well casing.

3.2.7 Groundwater Sampling

Groundwater samples were collected from DPT locations, temporary monitoring wells, and permanent monitoring wells at the IAAAP sites. Groundwater samples were collected using a peristaltic pump and disposable tubing from DPT locations or wells with depths to water of less than 30 feet bgs. In wells with depths to water greater than 30 feet, a submersible bladder pump was used to collect samples. Groundwater quality parameters (pH, specific conductance, turbidity, dissolved oxygen (DO), temperature, salinity, and oxidation-reduction potential) were collected using a water quality meter and were recorded on purge logs. Groundwater quality parameters were allowed to stabilize for three consecutive readings before each well was sampled.

Groundwater samples were collected in laboratory-prepared sampling containers that were pre-preserved based on the analytical method and submitted to Test America or Eurofins. See Section 5 for details on monitoring well sampling at the IAAAP sites in this RI report.

3.2.8 Surveying

New monitoring wells were surveyed by State of Iowa–licensed professional surveyor Bruner, Cooper & Zuck. The surveyors set up horizontal and vertical control for the site. Accuracy of the control was held to the Third Order Class I as outlined in the *Geospatial Positioning Accuracy Standards, Part 4: Standards* *for Architecture, Engineering, Constructions (A/E/C) and Facility Management* (Federal Geographic Data Committee, 2002).

The surveyor provided coordinates of the points *x*, *y*, and *z* to the nearest 0.01 foot. Horizontal coordinates conformed to North American Datum (NAD) 83 and the vertical elevations were referenced to National Geodetic Vertical Datum (NAVD) 88 with ties to the Iowa State Plane Coordinate System. Appendix E contains the survey report.

Soil borings and temporary well locations were surveyed using a global positioning system (GPS). Locations of new soil borings were determined using real-time kinematic GPS coordinates, with GPS accuracy dependent on site-specific conditions such as canopy cover.

3.2.9 Decontamination and Waste Management

Decontamination and waste management activities were conducted in accordance with the final *Basewide Environmental and Waste Management Plan* (CH2M, 2018b). Investigation-derived waste (IDW) generated during the RI included drill cuttings from the soil borings and monitoring well installations, well development and purge water, and decontamination fluids used to decontaminate nondisposable sampling equipment. New, United Nations–approved 55-gallon steel drums were used to contain waste generated during the field activities.

Groundwater generated during well development was temporarily stored in labeled drums or portable tanks. Groundwater was disposed of at the onsite Inert Disposal Area groundwater treatment facility with approval from IAAAP.

Downhole and nondisposable sampling equipment was decontaminated immediately after each use. Water generated during decontamination of sampling equipment was collected and transferred to an onsite groundwater treatment facility. Reusable heavy equipment, such as drilling rods and augers, was decontaminated before and in between the collection of each sample using a high-pressure steam cleaner with potable-grade water. Pressure washing was conducted at temporary decontamination pads. Decontamination fluids were captured and containerized for disposal at the onsite groundwater treatment facility.

IDW was temporarily stored at the installation approved staging location and properly labeled. The soil drums were sampled by CH2M for waste characterization. Based on the analytical results, IDW was classified as nonhazardous and disposed of at the Des Moines County Regional Landfill in West Burlington, Iowa, and the Clean Harbors facility in Cincinnati, Ohio. Appendix D contains the final executed manifests.

3.3 Data Management and Evaluation

3.3.1 Data Tracking

Data management and tracking was conducted from the time of field collection to receipt of validated electronic analytical results. Field samples and their corresponding analytical tests were recorded on the chain-of-custody forms submitted with the samples to the laboratory. Chain-of-custody entries were checked against the site-specific project instructions and work plans to verify that the designated field samples had been collected and submitted for the appropriate analysis. Upon receipt of the samples by the laboratories, a comparison to the field information was conducted to verify that each sample was analyzed for the correct parameters, and appropriate quality assurance/quality control samples were collected.

3.3.2 Data Quality Assessment

CH2M performed a data review and verification as described in the UFP-QAPP (CH2M, 2017a). The data quality of analytical results from the samples collected during the field investigation was assessed.

Analytical data were validated as Stage 2B level evaluations. Qualifier flags were applied to the data to reflect data usability limitations. The data review and verification efforts are documented in the data quality evaluation report (Appendix B).

The results are usable for project objectives, unless otherwise detailed in Appendix B. Based on the verification effort, the data appear to accurately represent the conditions of the environmental media analyzed at the time of collection, as detailed in Section 5. The analytical techniques were properly performed and documented, and the laboratory procedures applicable to each method were followed and documented. Standard industry laboratory methods were used to analyze the data as prescribed in the approved UFP-QAPP (CH2M, 2017a). Summary tables of the reported data, including both detections and nondetects, are included in Section 5.

Approach for RI Data Evaluation

Data from previous investigations were used to assess the nature and extent of contamination and evaluate for potential unacceptable impacts. This section describes the approaches used for the RI data evaluation for the IAAAP sites.

4.1 Nature and Extent Approach

4.1.1 Site Characterization Project Action Limits

In accordance with the final UFP-QAPP (CH2M, 2017a), screening values used for site characterization differ from those used to select chemicals of potential concern (COPCs) in the risk assessments. The site characterization screening levels (SLs) were used to assess the distribution and nature and extent of chemicals, whereas more conservative screening values were used for risk assessment (see Section 4.3.2). The final selected project action limit (PAL) objectives are summarized in Appendix F.

For site characterization, chemical concentrations were compared with PALs listed in the final UFP-QAPP (CH2M, 2017a). The PALs considered for the IAAAP sites included in this report are summarized below:

- Soil based on human health:
  - USEPA Regional Screening Level (RSL) for residential soil (hazard quotient [HQ] = 1), May 2022 (USEPA, 2022a).
- Soil based on ecological goals:
  - USEPA Region 4 Ecological Screening Values (ESVs) (USEPA, 2018b).
  - USEPA Region 5 Ecological SLs for Soil (USEPA, 2003a).
- Groundwater based on human health (maximum contaminant level, or MCL, to be used; if no MCL is available, the greater of the Health Advisory Level and the RSL):
  - Federal MCL, March 2018 (USEPA, 2018c).
  - USEPA RSL for tap water (HQ = 1), May 2022 (USEPA, 2022a).
  - Health Advisory Level (lifetime), March 2018 (USEPA, 2018c).
- Sediment based on human health:
  - HHRA sediment RSL (HQ=1) for a recreational scenario (USEPA, 2022a).
- Sediment based on ecological goals (listed in the order of selection):
  - USEPA Region 4 ESVs Values (USEPA, 2018b).
  - USEPA Region 5 Ecological SLs for Sediment, August 2003 (USEPA, 2003a).
  - USEPA Region 3 Biological Technical Assistance Group for Freshwater Sediment, August 2006 (USEPA, 2006a).
- Surface water based on human health (lowest of the two objectives):
  - Iowa Ambient Water Quality Criteria Standard, Fish Consumption, Iowa Administrative Code (IAC), Chapter 61 (2019).
  - HHRA Surface Water RSL (HQ=1) for a recreational scenario (USEPA, 2022a).

- Surface water based on ecological goals (listed in the order of selection):
  - Iowa Ambient Water Quality Criteria Chronic, IAC Chapter 61 (2019).
  - USEPA National Recommended Water Quality Criteria—Aquatic Life Criteria Table (USEPA, 2022d).
  - USEPA Region 4 ESVs (USEPA, 2018b).
  - USEPA Region 5 Ecological SLs for Surface Water, August 2003 (USEPA, 2003a).
  - USEPA Region 3 Biological Technical Assistance Group for Freshwater, July 2006 (USEPA, 2006b).

4.1.2 Background Threshold Values

USEPA's (2002) *Role of Background in the CERCLA Cleanup Program* states that risk management and remedial actions for CERCLA sites should account for the influence of natural and anthropogenic background conditions, and that cleanup goals for COCs from an identified CERCLA release should not be set for levels less than their corresponding background concentrations. Background concentrations for natural and anthropogenic chemicals are also used for comparison to site data to support the identifications of a site-related release.

Accordingly, analytical data were compared to the background values calculated for the IAAAP to assess whether the detected concentrations were consistent with the background concentrations for metals; site-specific discussions are included in Section 5. Background threshold values (BTVs) were calculated for groundwater at IAAAP and documented in the final *Evaluation of Background Concentrations of Metals in Groundwater* (CH2M, 2020a). BTVs were also developed for sediment and surface water specific to three of the watersheds at IAAAP: Brush Creek, Long Creek, and Spring Creek. BTV calculations are documented in the draft *Evaluation of Background Concentrations of Metals in Sediment and Surface Water* (CH2M, 2020b). BTVs are presented in the site-specific screening tables in Section 5 of this report.

4.2 Chemical Fate and Transport Overview

The properties of chemicals and the environment are used to understand and predict chemical fate and transport. An understanding of the fate and transport is part of the overall assessment of the potential for a chemical to cause an adverse human health or environmental effect. This section provides an overview of the fate and transport properties of chemicals previously identified as COPCs at IAAAP. Site-specific discussions are included in Section 5.

Based on previous investigations at IAAAP, the main COPCs that occur at the IAAAP sites are in five contaminant classes: explosives, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals. Semivolatile organic compounds other than the PAHs were rarely considered to be site-related, and pesticides were detected infrequently.

4.2.1 Chemical Mobility and Persistence

The mobility and persistence of potential contaminants are determined by their physical, chemical, and biological interaction with the environment. Mobility is the potential for a chemical to migrate from a site, and persistence is a measure of how long a chemical will remain in the environment. Some of the mechanisms controlling mobility and persistence are described as follows:

- *Volatilization* occurs when a compound transfers from the aqueous phase to the gas phase. Measures of a chemical's tendency to volatilize from water and soil moisture include its vapor pressure and Henry's law constant (K_h). Volatilization tends to occur more readily from surface water, sediment, or shallow soil than from deeper soil or groundwater.

- *Sorption* occurs when a chemical adheres to and becomes associated with solid particles. The soil and sediment media likely to sorb chemicals are clays and organic matter. The conventional measure of sorption is the distribution coefficient (K_d). The K_d for organic chemicals is typically the product of the soil organic carbon partition coefficient (K_{oc}) of the chemical and the fraction of organic carbon in the soil. Metals sorption potential is a complex function of pH, organic content, oxide coatings, and other factors; therefore, K_d is not easily estimated by methods other than site-specific testing (USEPA, 1996). Generally, metals adsorption increases with pH and they most often sorb to clay minerals, organic matter, and iron and manganese oxyhydroxides.
- *Solubility* is a measure of the degree to which a chemical will dissolve in water. Highly soluble chemicals are more likely to be leached from soil by precipitation or runoff that infiltrates into the subsurface.
- *Degradation* is the deterioration or destruction of a chemical, either biologically (through biodegradation) or abiotically (through such processes as abiotic reduction, hydrolysis, and photolysis). Biodegradation of chemicals by microbial organisms occurs through metabolic or enzymatic processes. The rate of degradation is dependent on the chemical, biological, and physical conditions of the medium in which the contaminant is located.
- *Transformation* occurs when the valence state of metals is increased (oxidation) or decreased (reduction). It can be caused by changes in oxidation potential or pH and by microbial or nonmicrobial (abiotic) processes. Transformation may have a significant effect on the mobility of a metal, either increasing or decreasing it.

Physical and chemical properties for the primary COPCs identified at the IAAAP are summarized in Table 4.2-1.

4.2.1.1 Explosives

The explosives at the IAAAP are characterized by limited volatility, moderate solubility, and low sorption potential (U.S. National Library of Medicine, 2015). The explosives are subject to biodegradation; however, degradation occurs under varying mechanisms. RDX, which is the most prevalent explosive at the IAAAP, most favorably degrades under anaerobic conditions (Pennington et al., 1999) in which it is reductively degraded to hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine, then hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine, and subsequently to hexahydro1,3,5-trinitroso-1,3,5-triazine. Other intermediates may also be formed, such as formaldehyde, methanol, hydrazine, 1,1-dimethylhydrazine, and 1,2-dimethylhydrazine (Battelle, 2015). RDX is also subject to abiotic degradation and can be transformed to methylene dinitramine. However, it will not be completely degraded to carbon dioxide via this mechanism alone.

In comparison, TNT can be aerobically biodegraded, reduced by hydrogen under anaerobic conditions, or degraded by biotic cometabolism. TNT can be also degraded abiotically by hydrolysis or reduced by iron. Amino-dinitrotoluenes (DNTs) are intermediate transformation products of TNT reduction under oxic or anoxic conditions (Battelle, 2015). 4-Amino-2,6-DNT is also a daughter product of the abiotic transformation of TNT.

HMX can be biodegraded under anaerobic conditions, most favorably under sulfate-reducing conditions. It will degrade to methane and chloroform under anaerobic conditions when a mixed microbial consortium is present (Battelle, 2015).

2,4-DNT and 2,6-DNT can be biodegraded under aerobic and anaerobic conditions. However, 2,4-DNT can be resistant to aerobic biodegradation under certain conditions (ATSDR, 2013). The DNTs can be used as the sole energy source or degraded via cometabolism with ethanol, methanol, and acetic acid. Potential aerobic degradation products include amino-nitrotoluene isomers, carbon dioxide, nitrite, and nitrate. Nitrite can inhibit further 2,6-DNT degradation. Anaerobic degradation can also result in diaminotoluenes. 2,4-DNT and 2,6-DNT are subject to abiotic degradation via photolysis, ozonation and chlorination, or oxidation by strong oxidants. The presence of the amino-DNT isomers (such as, 4-amino-2,6-DNT) in groundwater may be byproducts of anaerobic biodegradation of 2,6-DNT. These amino-DNTs can be further degraded to nitrotoluenes (McFarlan, 1998).

4.2.1.2 Volatile Organic Compounds

VOCs detected at the IAAAP include chlorinated volatile organic compounds (CVOCs); benzene, toluene, ethylbenzene, and xylenes (BTEX); and Freon 113. The K_h values for VOCs indicate that they are expected to volatilize quickly from surficial soil and surface water (U.S. National Library of Medicine, 2015). The VOCs are also characterized by relatively high solubilities and low sorption potential. CVOCs are subject to degradation by biological and abiotic mechanisms. Under anaerobic conditions, biodegradation typically occurs by reductive dechlorination, a naturally occurring process in which chlorine atoms on a parent CVOC molecule are sequentially replaced with hydrogen. Some CVOCs can be aerobically biodegraded via aerobic cometabolism to carbon dioxide. They are also subject to abiotic degradation, mainly mediated by iron-bearing minerals in the subsurface under reducing conditions. Aromatic VOCs, such as BTEX, can be biodegraded in oxidation-reduction reactions, in which the contaminant is used as the electron donor by the microorganism. Biodegradation will occur when enough electron acceptors, electron donors, and nutrients are available in groundwater. Freon 113 has been observed to undergo biodegradation under anaerobic and aerobic conditions; however, the degradation rate may be slow, and the contaminant may be persistent (U.S. National Library of Medicine, 2015).

4.2.1.3 Polycyclic Aromatic Hydrocarbons

PAHs are a group of organic compounds consisting of two or more rings comprising six carbon atoms. The number of rings significantly affects the properties of the molecule. High-molecular-weight PAHs, such as benzo(a)pyrene, generally have limited volatility, very low water solubility, and high sorption potential. On the contrary, low-molecular-weight PAHs, such as naphthalene, have moderate volatility, moderate water solubility, and moderate sorption potential (U.S. National Library of Medicine, 2015). Therefore, naphthalene has greater mobility than high-molecular-weight PAHs.

PAHs can be biodegraded under aerobic and anaerobic conditions (U.S. National Library of Medicine, 2015). However, aerobic biodegradation occurs at a much faster rate. The principal mechanism for aerobic metabolism is the initial oxidation of the benzene ring by the action of oxygenases. Nevertheless, PAHs sorbed to organic matter may be less available for biodegradation. In general, high-molecular-weight PAHs are more recalcitrant than low-molecular-weight PAHs and as a result have longer half-lives.

4.2.1.4 Pentachlorophenol

Pentachlorophenol (PCP) has been observed to degrade anaerobically by reductive dechlorination. To complete anaerobic degradation, each chlorine molecule acts as an electron acceptor and is replaced by hydrogen, producing first tetrachlorophenol (TeCP), then trichlorophenol (TCP), dichlorophenol (DCP), chlorophenol (CP), and finally phenol before the aromatic ring is broken relatively late in the process. Possible intermediate breakdown products include three isomers of TeCP, five isomers of TCP, six isomers of DCP, and three isomers of CP. The pathway that is followed at a specific site appears to depend on the type of microorganism present in the system (Mahaffey, 1997). In order for anaerobic degradation of PCP to occur, highly anaerobic conditions must exist in the aquifer; DO levels less than 0.5 mg/L are necessary in the groundwater.

In the aerobic degradation of PCP, the phenol ring is broken during an early stage of the process, and complete mineralization to carbon dioxide, water, and chloride occurs much more quickly than through the anaerobic pathway. Initial intermediate products that form prior to breaking the phenol ring may include tetrachloroatechol, tetrachlorohydroquinone, tetrachlorobenzoquinone, trichlorohydroxylbenzoquinone, tert-butylhydroquinone, dichlorohydroquinone, and chlorohydroquinone (Mahaffey, 1997). For aerobic oxidation to occur, a DO concentration in the groundwater of at least 2 mg/L is typically required.

4.2.1.5 Polychlorinated Biphenyls

The most common PCBs detected at IAAAP were Aroclor 1254 and Aroclor 1260. These chemicals are relatively immobile in the environment and are persistent. PCBs have moderate volatility, high sorption potential, and low water solubility. Higher-weight PCBs (such as Aroclors 1254 and 1260) are resistant to aerobic biodegradation (U.S. National Library of Medicine, 2015). Anaerobic reductive dechlorination of these PCBs can occur but may require enhancement to achieve effective degradation rates. These PCBs do not significantly degrade abiotically in the environment.

4.2.1.6 Metals

Due to the complexity of metals and their variable forms in the environment, predicting their chemical mobility and persistence can be difficult. Typically, they are not volatile under normal temperature and pressure conditions. Their sorption potential is a complex function of pH, organic content, oxide coatings, and other factors; therefore, K_d is not easily estimated by methods other than site-specific testing (USEPA, 1996). Generally, metal adsorption increases with pH. Metals most often sorb to clay minerals, organic matter, and iron and manganese oxyhydroxides. Metals may be sorbed on the surface of the soil or fixed to the interior of the soil, where they are unavailable for release to groundwater. After available sorption sites are filled, most metals are incorporated into the structures of major mineral precipitates as coprecipitates (ERG, 2005).

The solubilities of metals are also dependent on several factors. In general, solubility is highly dependent on the oxidation state of the metal (USEPA, 2007). The solubility of cations (positively charged ions) decreases as pH increases. Some cations may complex with oxygen and hydroxide, forming insoluble oxyhydroxides, or with phosphate, sulfate, and carbonate, forming insoluble mineral precipitates. Metal sulfide complexes, which form in reducing environments, are extremely insoluble and tend to reduce the total metals concentrations (ERG, 2005).

The solid forms of iron (iron hydroxides) and manganese (manganese oxides) are present in the natural soil matrix. If insufficient amounts of oxygen and nitrate are present in the subsurface, then iron hydroxides and manganese oxides will be used as electron acceptors during metabolic activity and dissolve under reducing conditions into soluble forms. Sulfides present in groundwater can also result in the dissolution of iron hydroxides. Several metals (such as arsenic) tend to sorb to these iron hydroxides and manganese oxides. If these iron and manganese compounds are dissolved, the metals that are bound to these hydroxides and oxides (such as chromium and arsenic) will also be released. Iron also becomes more soluble as pH drops to less than 7 (ERG, 2005).

Subsurface conditions are likely to become more reduced in areas that have substantial carbon available. Several metabolic processes can use naturally occurring organic carbon or anthropogenic organic compound contamination as an electron donor or electron acceptor. Metal concentrations, in particular iron and manganese and those metals that tend to desorb from iron and manganese oxyhydroxides when they are reduced to their more soluble forms, are also frequently greater in areas of organic contamination (such as explosives or VOC plumes) because of the reducing conditions that are created during biodegradation of these chemicals (USEPA, 2017a).

4.2.2 Chemical Transport

Contamination at the IAAAP is attributed primarily to historical load, assemble, and pack operations for ammunitions. In particular, there appear to be several contaminant plumes emanating from wastewater treatment buildings along the production lines. Sources of contamination at the individual sites are discussed in Section 5.

Figure 2-9 depicts the CSM for the IAAAP and supports the fate and transport discussion. It qualitatively combines and interprets physical characteristics and the nature and extent of contamination. Primary migration pathways for potential contaminants at IAAAP include the following:

- Volatilization of contaminants in surface soil and surface water.
- Volatilization of contaminants in subsurface soil and shallow groundwater due to construction/ excavation activities.
- Volatilization of contaminants into unsaturated zone soil gas at the water table interface.
- Transport of contaminants sorbed to soil via historical wastewater discharge, stormwater runoff/ erosion, and wind erosion to drainage ditches.
- Leaching of contaminants in soil to groundwater.
- Advection of dissolved contaminants with groundwater flow.
- Discharge of contaminants in groundwater through sediment and into surface water.
- Surface water transport of chemicals within drainage ditches and creeks.

Migration pathways for potential contaminants at IAAAP are further discussed in the following subsections in the context of their location (i.e., unsaturated zone, surface water, sediment, stormwater, and saturated zone migrations).

4.2.2.1 Unsaturated Zone Migration

Contaminants released to the ground surface migrated through the unsaturated zone, as controlled by the chemical and physical differences between the contaminants and the surrounding media, gravity, and pressure (head). Once in the unsaturated zone, contaminants may have sorbed to soil or organic matter, become trapped in residual pore spaces, or continued to leach to the saturated zone. Although the explosives and VOCs have lesser K_{oc} values, the contaminants could still sorb to soil in areas of greater clay or total organic carbon content. The high-molecular-weight PAHs and PCBs have a strong tendency for sorption. Once in the soil, contaminants can enter the gas phase through volatilization of soil contaminants. Higher soil temperatures in the upper few feet of soil occur during the summer and can lead to increased volatilization. Chemicals sorbed or complexed to surface soil may be transported to sediment via surface water runoff.

The IAAAP includes areas that are covered by asphalt, concrete, buildings, and heavy vegetation. In portions of the site that are covered by impermeable asphalt or concrete, infiltration into the subsurface and potential leaching of contaminants in the unsaturated zone is significantly limited. In those areas of the site that are vegetated, there is little to no restriction for infiltration. Explosives, VOCs, and low-molecular-weight PAHs have leached from the unsaturated zone to groundwater. In contrast, due to the high sorption potential and low water solubility of high-molecular-weight PAHs and PCBs, these contaminants are largely immobile in the unsaturated zone and unlikely to appreciably leach to groundwater. Based on their moderate volatility, PCBs may evaporate into soil gas and then into the atmosphere.

Most metals at the IAAAP are naturally occurring in the environment and not associated with a CERCLA release. In southeast Iowa, iron and manganese have been identified as being problems and are frequently detected at concentrations greater than recommended screening values (Coble, 1971). The mobility of metals in the unsaturated zone is highly dependent on the subsurface conditions. Surface soil and shallow subsurface soil (within the top 2 feet of the ground surface) exist under more oxidizing conditions due to the proximity to outdoor air; therefore, aluminum, manganese, and iron will tend to be in their immobile forms of aluminum hydroxides, manganese oxides, and iron hydroxides. In oxidizing environments, arsenic and chromium are typically present in forms that are more mobile. However, these metals, along with lead, thallium, and zinc, will potentially sorb or complex with clays, organic material, iron hydroxides, or manganese oxides, limiting their mobility.

4.2.2.2 Surface Water, Sediment, and Stormwater Runoff Migration

Intermittent stormwater runoff can transport contaminants in surface soil and deposit them potentially in creeks at the IAAAP. Transport occurs when contaminants are either dissolved in the stormwater/runoff or sorbed to particulate matter small enough to be carried by the intermittent stormwater flow. Runoff may be locally limited by vegetation, where present.

Once the contaminants are transported to the surface water features, they can be further carried with surface water flow. Heavier particles will tend to deposit to the bottom as sediment unless the surface water flow is strong. Volatilization of volatile contaminants would be rapid from shallow surface water, particularly if there is shallow turbulent flow, such as that which occurs in small creeks.

Within the creeks, explosives and VOCs would be expected to dissolve in surface water. The VOCs would volatilize quickly, but the explosives would be more likely to stay dissolved in water. Any high-molecular-weight PAHs and PCBs would preferentially stay sorbed to sediment and be migrated only via particle entrainment. Low-molecular-weight PAHs and PCBs may moderately volatilize into the atmosphere. In contrast, high-molecular-weight PAHs are unlikely to evaporate. Unlike surface soil, sediment is often subject to more reducing conditions due to the presence of organic matter, which may facilitate biological redox reactions.

4.2.2.3 Saturated Zone Migration

Contaminants have entered groundwater at the IAAAP primarily by leaching through unsaturated zone soil. However, sumps at the IAAAP, which were located below the water table, may have also contributed to groundwater contamination. Contaminants in the overburden aquifer have been transported from the source release areas through advection and dispersion. Advection is the primary transport mechanism and includes the transport of dissolved contaminants by the bulk motion of flowing groundwater. Dispersion is the spreading of dissolved contaminants from the path they would be expected to follow during advection due to the spatial variation in aquifer permeability, fluid mixing, and molecular diffusion. Contaminants in groundwater may volatilize into unsaturated zone soil gas at the water table interface.

Groundwater flow in the overburden aquifer is influenced by the hydrologic watersheds and flows generally southeasterly or southwesterly toward Brush Creek, Long Creek, Spring Creek, and the Skunk River. Groundwater contaminants near these waterbodies may discharge through sediment and into surface water in portions of the creeks that are considered gaining. Due to differences in the permeability, groundwater discharge is greater in the alluvium than in the glacial till. However, when surface water levels are high, during periods of high precipitation, surface water may serve as a recharge point for groundwater. Groundwater contaminants may also discharge into localized drainage ditches; however, this is less likely since the drainages are often dry at the IAAAP. Groundwater discharge to surface water bodies is indicated by upward vertical gradients. Overburden aquifer groundwater can also flow downwards toward the bedrock aquifer. This would be indicated by downward vertical gradients. However, contaminant migration between the aquifers would be limited due to physical differences between the surficial (overburden) geology and the primary bedrock matrix and pressure (head). Groundwater in bedrock flows primarily through secondary porosity features, like fractures. Where the bedrock crops close to the surface, groundwater flow is also influenced by the watersheds.

Contaminants typically will not move as rapidly as groundwater because of retardation, or the adsorption of the contaminant to the solid media. Retardation can be a significant factor for groundwater COPCs within the overburden aquifer, which is composed primarily of clays and silts. Retardation will not be important where sand lenses are present from the glacial meltwater.

As previously mentioned, organic contamination in groundwater is composed primarily of explosives and VOCs. The explosives have moderate solubilities, but relatively low sorption potential. Therefore, they are subject to moderate migration, which may vary based on the specific chemical. The VOCs in groundwater may volatilize into soil gas overlying the water table. These chemicals also have high to moderate aqueous solubilities and have the potential to migrate once dissolved in groundwater. All of the organic groundwater COPCs are subject to biodegradation.

Transport and partitioning of metals in water is dependent on the oxidation state of the metal and on interactions with other materials present. Under reducing conditions, iron and manganese would be expected to be transformed into more soluble forms. Any metals (such as arsenic and zinc) which may be naturally bound to iron hydroxides and manganese oxides can also become more mobile. Arsenic can also coprecipitate in groundwater.

4.3 Risk Assessment Approach

Risk assessments were conducted to assess the potential for unacceptable risk or hazards to human health and the environment posed by site-related contamination. The media evaluated for the areas included in this report are detailed in Section 5 and summarized as follows (Table 4.3-1):

Table 4.3-1. Media Evaluated for Unacceptable Risks at IAAAP Sites Included in OU-6 Report
Iowa Army Ammunition Plant, Middletown, Iowa

IAAAP Area	AEDB Site	Media Evaluated in RI Report
Line 1	CC-IAAP-001G	Groundwater
Line 1 Former Wastewater Impoundment	IAAP-016	Soil
	IAAP-016G	Groundwater, surface water, and sediment
Line 2	IAAP-002G	Groundwater
Line 3	IAAP-003G	Groundwater
Line 3A	IAAP-004G	Groundwater
Lines 5A and 5B	IAAP-006G	Groundwater
Line 800 and Pinkwater Lagoon	IAAP-044	Soil
	IAAP-044G	Groundwater, surface water, and sediment
Line 9	IAAP-010G	Groundwater

Risk assessments were not conducted for soil, sediment, and surface water within (1) the impoundment pond located within the Line 1 Former Wastewater Impoundment or (2) the pinkwater pond located within Line 800 and Pinkwater Lagoon, as these media are being addressed by an ongoing interim remedial action, and historical concentrations are no longer applicable. Risk assessments were also not conducted for soil media at the other sites, as soil is not a component of this RI; soil is addressed under the remedy for OU-1 at Line 1, Line 2, Line 3, Line 3A, Lines 5A and 5B, and Line 9.

4.3.1 Human Health Risk

This section provides the general methods used in the HHRAs. As noted in Section 1.2.4, site-specific discussions for the IAAAP sites included in this report are provided in Section 5. The results of the site-specific HHRAs are also included in Section 5 to provide a more comprehensive CSM for each of these IAAAP areas. The supporting risk tables are provided in Appendix A.

The approach and assumptions used in the HHRA are consistent with those provided in the final UFP-QAPP (CH2M, 2017a), except for some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final UFP-QAPP, and are consistent with those provided in the interim HHRAs for Line 2, Line 6, and Building 600-86 (CH2M, 2019a, 2020c; Leidos, 2020). While the only site evaluated in this RI that was included in the HHRA interim deliverables was Line 2, the IAAAP project team agreed that these interim deliverables would serve as examples for the HHRA approach at all of the IAAAP sites, including the sites in this OU-6 RI report. The purpose of these interim deliverables, as stated for Superfund sites in the USEPA's *Risk Assessment Guidance for Superfund (RAGS*), is to present the planning documents, specifically RAGS Part D Tables. The interim HHRAs presented the exposure scenarios, analytical data, data groupings, results of the screening for COPCs, exposure point concentrations (EPCs) in exposure media, exposure factor values for receptors, and toxicity values for the COPCs.

HHRAs were completed for all of the IAAAP sites included in this RI report. The primary objective of each HHRA was to evaluate and document the potential risks and hazards to human health associated with potential current and future exposures to chemicals at these IAAAP sites in the absence of any remedial action. The HHRAs were completed in accordance with *RAGS, Volume I, Human Health Evaluation Manual* (HHEM)*,* Parts A, D, E, and F (USEPA, 1989, 2001a, 2004, 2009); HHEM *Supplemental Guidance: Update of Standard Default Exposure Factors* (USEPA, 2014a); and *Risk Assessment Handbook, Volume I: Human Health Evaluation* (USACE, 1999). If there are inconsistencies between the methods presented in the USACE and USEPA guidance documents, preference is given to USEPA guidance in the risk assessment.

The HHRAs consist of a four-step evaluation process:

1. **Data evaluation and identification of COPCs.** Identification of the appropriate HHRA data set and selection of the COPCs, including concentration contributions from both site-related COPCs and naturally occurring chemicals. COPCs identified in this step are the focus of the subsequent steps of the HHRA.
2. **Exposure assessment.** Identification of potential pathways of human exposure, characterization of the potentially exposed populations, and estimation of the magnitude, frequency, and duration of exposures.
3. **Toxicity assessment.** Assessment of the potential adverse effects of the COPCs (site-related COPCs and naturally occurring chemicals) and compilation of the toxicity values used for developing numerical risk and hazard estimates.
4. **Risk characterization.** Integration of the results of the exposure and toxicity assessments to develop numerical estimates of potential health risks and hazard, including a discussion of sources of uncertainty associated with the data, method, and exposure and toxicity values used in the HHRA. For each IAAAP site, the risk characterization is a four-step process that (1) presents estimates of potential risks and hazards that include contributions from site-related COPCs and naturally occurring chemicals; (2) presents risks and hazards due to background and identifies naturally occurring chemicals; (3) presents risks and hazards from site-related COPCs; and (4) through weight-of-evidence evaluations, identifies final COCs, if any, that warrant further evaluation in a Feasibility Study. The identification of no COCs indicates the conditions for NFA are met on an HHRA basis.

4.3.1.1 Potential Receptors

The following potential current and future human receptors were considered for the IAAAP sites included in this RI report, and the exposure scenarios applicable to each site are discussed in the HHRAs, as provided in Section 5. Soil is not evaluated in the HHRAs for the OU-6 sites because soil has either been addressed under OU-1 or an interim remedial action is in place, as discussed in the HHRAs in Section 5.

Potential Current Exposure Scenarios

- **Hunters/Recreators.** Hunters/recreators could be exposed to surface water and sediment while wading in perennial water bodies when hunting and recreating. To effectively manage the overpopulation of deer, limited recreational hunting is permitted at some areas within IAAAP (Appendix A-1). Recreational trapping of fur-bearing mammals is also allowed during limited times of the year. For an individual site, potential exposures to hunters were evaluated only if hunting/trapping is permitted at the site, as shown in Appendix A-1, Attachment 1.
- **Site Workers.** Site workers could be exposed to COPCs in indoor air (which may be impacted by VOCs migrating from groundwater). Potential indoor air exposures to current site workers would only be considered at sites with currently active buildings. The active buildings at the IAAAP areas included in this RI report were identified by IAAAP personnel and are provided in Appendix A-1, Attachment 2. As shown, there are active buildings at two of the IAAAP areas included for risk assessment (Line 1 and Line 3A). Additionally, a current site worker scenario was only evaluated in the HHRA if the estimated risks and hazards for a hypothetical residential scenario exceeded acceptable risk and hazard levels and COCs were identified for a residential scenario.

Potential Future Exposure Scenarios

- **Site Workers.** Future site workers could contact groundwater if groundwater is used as a future drinking water source at the IAAAP sites. Additionally, future site workers could contact COPCs in indoor air (that may be impacted by VOCs migrating from groundwater) in existing buildings or in potential future buildings if a site is redeveloped. However, potential exposures and risks and hazards to site workers were estimated in the HHRAs only if the estimated risks and hazards for a hypothetical residential scenario exceeded acceptable risk and hazards levels and COCs were identified for a residential scenario.
- **Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert. Contact with shallow groundwater while performing repairs or maintenance activities on a culvert is assumed to be for 1 hour per day, 6 days per week for 2 weeks per year. Potential exposures and risks and hazards to construction/utility workers are estimated in the HHRAs only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk and hazard levels and COCs were identified for a residential scenario. Based on conversations with staff at IAAAP, replacing culverts is infrequent (i.e., every few years over a duration of approximately 2 weeks), and contact with shallow groundwater is expected to be minimal (i.e., less than 1 hour per day during culvert replacement). Additionally, repairs to sewer or water lines are very infrequent, are completed in 1 or 2 days, and are too insignificant to evaluate in the HHRAs.
- **Hypothetical Residents.** Future hypothetical residents (young child ages 0 to 6 years and adult) may contact groundwater based on potential future use as a potable water source at the IAAAP sites. Additionally, future residents could contact COPCs in indoor air (that may be impacted by VOCs migrating from groundwater) if future residences are constructed at the IAAAP areas included in this report. Although the current and expected future Land Use of the IAAAP is Commercial/Industrial, hypothetical future residents are being evaluated for exposures to groundwater at the OU-6 areas as a means for determining if the conditions meet the criteria for NFA or UU/UE. Although none of the areas at the IAAAP are anticipated to undergo residential redevelopment, the hypothetical residential scenario allows for evaluation of the least restrictive land use scenario. According to *Land Use in the CERCLA Remedy Selection Process* (USEPA, 1995), the presence of contaminants in media at concentrations protective of residential exposures allow for unrestricted land use and negates the need for further action for a human health risk scenario.

The human health conceptual exposure model (CEM) for each IAAAP site in this report is discussed in Section 5. The media and potential exposure scenarios evaluated for each site are provided in Table 4.3-2.

4.3.1.2 Data Evaluation and Identification of Chemicals of Potential Concern

Data Evaluation

The data evaluation step involves gathering and reviewing available site data and identifying a data set of acceptable quality for the HHRAs. Groundwater samples from historical investigations and from the recent investigations conducted between 2018 and 2020, as documented in the final UFP-QAPP (CH2M, 2017a), were included in the HHRAs. The historical data were evaluated to determine whether they were likely to still be representative of current site conditions. The data sets included in the HHRAs for each site are discussed in Section 5.

The data were evaluated using the following procedures:

- A value qualified as “B”, “D”, “E”, “J”, or “P” was treated as a detected value.
- “U” qualified results were treated as nondetected values.
- “UJ” qualified results were treated as nondetected values, with the reporting limit (RL) being estimated.
- “R” (rejected) qualified results were not included in the HHRA data sets.
- For sample locations where a duplicate sample or a split sample was collected, the greatest detected concentration among the original, duplicate, or split samples was used when a chemical was detected in any sample. If all results were nondetect, the lowest reported detection limit (DL) (that is, RL) was used.

Groundwater Data Groupings

For a future potable use scenario, groundwater samples collected from the overburden and bedrock aquifers within a site boundary were combined (if bedrock groundwater was potentially impacted and sampled), and groundwater was assumed to be potable at all depths. USEPA guidance (USEPA, 2014b) recommends that only “total” concentrations be used to evaluate a potable use scenario if both “total” and “dissolved” metals data are available in the groundwater data set; therefore, only “total” metals data were presented in the risk assessment tables and text of the HHRAs. However, for informational purposes and to provide weight of evidence when evaluating groundwater risk and hazard estimates, dissolved metals data were also evaluated and included as an attachment to the HHRAs.

For the VI pathway, groundwater samples collected from the overburden and bedrock aquifers within a site boundary were combined. The groundwater samples were not collected at multilevel wells; therefore, a separate data grouping was not used to evaluate the VI pathway (i.e., the same data grouping was used for potable use and the VI pathway scenarios).

Surface Water/Sediment Data Groupings

Surface water and sediment samples were collected from perennial surface water features and were used to evaluate hunting and other recreational activities if permitted at these sites.

Selection of Site-related Chemicals of Potential Concern and Naturally Occurring Chemicals

The COPCs (site-related COPCs or naturally occurring chemicals) are those chemicals that, based on screening, have the potential to cause adverse human health effects if receptors contact site media. Chemicals considered to be essential nutrients (calcium, magnesium, potassium, and sodium) were not selected as COPCs in the HHRAs because they are toxic only at large doses, and high concentrations of essential nutrients are not present at the sites.

Chemicals that were 100 percent not detected in a data grouping were not identified as COPCs for that data grouping; however, an evaluation of the 100 percent nondetected chemicals within a medium was included in the Uncertainty Analysis sections in the HHRAs. DLs and RLs (if available) for chemicals that were 100 percent not detected in a medium were compared against SLs. Chemicals with exceedances are discussed regarding the age of data, the potential to be related to former site activities, and the potential to be associated with laboratory contamination. The detection of a chemical within that medium on an IAAAP facility-wide basis at a frequency greater than 5 percent (based on historical non-FUSRAP facility data) was also considered when determining the significance of the DL or RL greater than its SL and its potential to be site-related. The results of the evaluation for the nondetected chemicals are provided in Section 5.

Screening Levels

The SLs used in the HHRA for each exposure medium are described below. A detected chemical was retained as a COPC (site-related COPC or naturally occurring chemical) in an exposure medium if the maximum detected concentration exceeded the corresponding SL for that exposure medium.

- **Groundwater (Potable Use).** Concentrations detected in groundwater for a potable use scenario were compared to USEPA's tap water RSLs (USEPA, 2022a). For lead, the groundwater concentrations were compared to the USEPA's Action Level of 15 µg/L. USEPA's MCLs (USEPA, 2009a) were included in the groundwater screening tables for comparison purposes (i.e., as an applicable or relevant and appropriate requirement) but were not used to select COPCs. If an MCL was not available, the Lifetime Health Advisory (USEPA, 2018c) was provided for comparison purposes. The MCLs are enforceable standards and are used as a line of evidence in the risk characterization to determine final COCs in the HHRAs.
- **Groundwater Vapor Intrusion.** Concentrations detected in groundwater for the VI pathway were compared to USEPA's groundwater vapor intrusion screening levels (VISLs), calculated using the VISL Calculator (USEPA, 2022b). The default groundwater to indoor air attenuation factor of 0.001 and IAAAP-specific average groundwater temperature of 13 degrees Celsius (based on groundwater samples collected from 2000 to 2018) were used in the VISL calculations. The VISL Calculator input and output is provided in Appendix A-1, Attachment 3. Chemicals detected in groundwater that were not considered to be sufficiently volatile were excluded as COPCs for the VI pathway. Chemicals with a Henry's Law Constant value greater than or equal to 1×10^{-5} atmospheres per cubic meter per mole or a vapor pressure greater than or equal to 1 millimeter Hg are considered by USEPA to be sufficiently volatile (USEPA, 2022a).
- **Surface Water/Sediment.** Concentrations detected in surface water and sediment were compared to SLs calculated for a recreational scenario (i.e., adult and adolescent hunters) using the RSL online calculator. An exposure frequency of 26 days/year and an exposure time of 2 hours/event was used; the body weight used for the adolescent hunter is 44.3 kilograms (kg). The RSL calculator input and output are provided in Appendix A-1, Attachment 4.

The RSLs and VISLs were based on a target excess lifetime cancer risk (ELCR) of 1×10^{-6} and a noncancer HQ of 0.1. The HQ of 0.1 was used as the target hazard level for noncarcinogenic health endpoints to account for the potential presence of multiple chemicals affecting the same target organ. For those chemicals with a carcinogenic-based RSL and a noncarcinogenic-based RSL, the lowest value was selected as the final RSL for that chemical. If the maximum detected concentration of a chemical exceeded its respective SL, it was retained as a COPC (site-related COPC or naturally occurring chemical) in the HHRA.

The BTVs are provided in the COPC screening tables for comparison purposes and were not used as a basis for selecting or eliminating COPCs. Instead, the BTVs are used to determine which chemicals are naturally occurring at the sites, as provided in the nature and extent evaluations in Section 5. The results of the background comparisons are used in the risk characterization process to distinguish between naturally occurring chemicals and site-related COPCs. If the site maximum detected concentration (MDC) is less than the upper tolerance limit (UTL) for the BTV, the metal is considered naturally occurring. If the site MDC is greater than the background upper tolerance limit, the metal is considered site-related. Note, the total chromium concentration in groundwater at all of the OU-6 sites was below the BTV. In these cases, there was no need to evaluate chromium, including hexavalent chromium, any further and a ratio approach for total and hexavalent chromium was not applied.

4.3.1.3 Exposure Assessment

An exposure assessment is used to evaluate potential exposures to site media by the human receptors identified for current and anticipated future land uses at the IAAAP sites. The exposure assessment identifies potential human receptors, potential exposure pathways, exposure factor values, and EPCs.

Exposure Pathways Quantified in the HHRA

An exposure pathway can be described as the physical course that a chemical takes from the point of release (or source) to a receptor. To be complete, an exposure pathway must have all the following components:

- A source (such as chemical residues in an environmental medium).
- A mechanism for chemical release and migration (such as groundwater infiltration).
- An environmental transport medium (such as groundwater).
- A point of potential human contact (exposure point, such as tap water).
- A route of intake (such as ingestion, dermal contact, or inhalation).

In the absence of any one of these components, an exposure pathway is considered incomplete, and, by definition, there is no risk or hazard. The potential exposure pathways quantified for each site are discussed in the HHRAs, in Section 5. Groundwater is not currently being used as a potable water source, and there are no plans to use groundwater for potable purposes; however, based on applicable CERCLA policy and guidance, groundwater at the IAAAP sites is classified as Class IIB, a potential source of drinking water (USEPA, 1989). This requires the evaluation of future residential exposures to groundwater. It is assumed that future hypothetical residents could use groundwater as a potable water source. Ingestion, dermal contact, and inhalation exposures to COPCs in groundwater were estimated in the HHRA based on a potable use scenario. Additionally, hypothetical future residents could also inhale volatile groundwater chemicals (if present in groundwater) that have migrated to indoor air from VI.

Exposure Point Concentrations

The upper confidence limit (UCL) of the mean concentration was calculated for each COPC where at least eight samples were available and at least four detected concentrations were observed. The UCLs were estimated following the most recent parametric (distributional) and nonparametric USEPA recommendations in ProUCL (Version 5.1.002) (USEPA, 2016). ProUCL provides approaches for calculating UCLs particularly when nondetected concentrations are present. These approaches consider a large variety of input, including the perceived distribution of the detected results (if no perceived distribution is acceptable, nonparametric alternatives are provided), sample size, variability, and skewness. The arithmetic mean concentrations provided in the RAGS Part D Table 3 series were calculated using only detected results. For exposure media where lead was identified as a COPC, the arithmetic mean concentration was used as the EPC.

If a groundwater plume was identified for a site, the groundwater EPCs were calculated based on the data collected in the core of the plume, in accordance with USEPA's *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b). A plume is interpreted as a threedimensional, dynamic (that is, may vary temporally), potentially irregular distribution of contaminants dissolved or suspended in groundwater (USEPA, 2014b). When eight samples and at least four detected concentrations were available from the core of the plume, the EPC was calculated as the UCL on the mean; otherwise, the maximum detected concentration was used as the EPC. If no plume was identified for a site, all samples in the groundwater data set were used to calculate the EPCs for the COPCs in groundwater. EPCs are also calculated as the UCL on the mean when eight samples and at least four detected concentrations were available for the site groundwater; otherwise, the maximum detected concentration was used as the EPC.

Exposure Factors and Exposure Calculations

A reasonable maximum exposure scenario was quantified for potential residential receptors under a hypothetical future land use scenario (USEPA, 1989). USEPA defines the reasonable maximum exposure as the greatest exposure that could reasonably be expected to occur for a given exposure pathway at a site and is intended to account for both uncertainty in the chemical concentration and for variability in the exposure parameters (such as exposure frequency or averaging time). If available, site-specific values are applied as equation inputs. In the absence of site-specific values, default values are obtained or calculated based on values provided in current USEPA guidance such as the HHEM *Supplemental Guidance: Update of Standard Default Exposure Factors* (USEPA, 2014a). The exposure factors used in the HHRAs are provided in the RAGS Part D Table 4 series for each site (Appendix A).

The exposure factors are used as equation inputs for calculating daily intakes for ingestion and dermal exposure routes and exposure concentrations (ECs) for the inhalation exposure route. A daily intake occurs when a chemical is taken into the body via ingestion or dermal contact and is subsequently absorbed into the bloodstream. In accordance with RAGS Part F (USEPA, 2009a), potential risks and hazards associated with inhalation exposures are assessed on a concentration basis rather than an intake-based approach. Depending on the exposure duration, exposures are characterized as chronic or subchronic. Daily intakes and ECs are calculated in accordance with the USACE's *Risk Assessment Handbook* (USACE, 1999), USEPA's RAGS Part A (USEPA, 1989), and USEPA's RAGS Part F Additionally, dermally absorbed doses are calculated for dermal exposures in accordance with USEPA's RAGS Part E (USEPA, 2004).

Calculations of daily intakes and ECs are provided in the RAGS Part D Table 7 series for each area-pathway-receptor combination (Appendix A). For hypothetical future residents, noncarcinogenic exposures are calculated separately for child (0 to 6 years) and adult residents as daily intakes or ECs. For carcinogenic exposures, daily intake rates and ECs are age-adjusted based on child (0 to 6 years) and adult parameters (e.g., intake rates, exposure duration, and body weights) and averaged over a lifetime (i.e., 70 years).

Approach for Mutagenic Exposures

Some carcinogenic COPCs are identified as acting with a mutagenic mode of action (MMOA); these COPCs are expected to cause irreversible changes to DNA (deoxyribonucleic acid) and would likely exhibit a greater effect in early-life versus later-life exposure. For COPCs identified to act with an MMOA for carcinogenesis (USEPA 2022a), in the absence of age-specific toxicity data, the risk for exposures that occur at early life stages was estimated by applying the default age-dependent adjustment factors (ADAFs) to address the potential for increased carcinogenic potency associated with exposure during early life (less than 16 years of age). Consistent with the *Cancer Guidelines* (USEPA, 2005a) and *Supplemental Guidance* (USEPA, 2005b), the estimated risks for specific age groups were calculated using the following ADAFs: less than 2 years (ADAF of 10), 2 to less than 16 years (ADAF of 3), and greater than 16 years (ADAF of 1).

Approach for Lead Exposures

The potential risks associated with lead exposures for a hypothetical residential scenario were addressed using the most recent version of the Integrated Exposure Uptake Biokinetic (IEUBK) Model and USEPA's recommended input parameter values (USEPA, 1994, 2010a, 2017b, 2017c, 2021). The IEUBK Model was designed to provide predictions of the probability of elevated blood lead levels (BLLs) for children. This model addresses three components of environmental risk assessments—the multimedia nature of exposures to lead, lead pharmacokinetics, and significant variability in exposure and risk—through estimation of probability distributions of BLLs for children exposed to similar environmental concentrations. The measured site concentration, calculated as the arithmetic mean, was used for the exposure medium where lead was identified as a COPC, and the default ECs embedded in the IEUBK Model were used for exposure media where lead is not a COPC.

In 2012, the Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) conducted a critical review of available lead toxicity studies and reported that the overall weight of evidence substantiates that neurocognitive decrements (as well as other adverse systemic effects, such as cardiovascular, immunological, and endocrine effects) can occur in children, even when BLLs are less than 10 micrograms per deciliter (µg/dL) (ACCLPP, 2012). Based on the conclusion that BLLs less than 10 µg/dL can harm children, the ACCLPP and Centers for Disease Control and Prevention (CDC, 2007) have recommended that a revised reference value of 5 µg/dL of blood lead be used to identify children with elevated BLLs. Therefore, the blood lead reference level of 10 µg/dL was replaced with the reference level of 5 µg/dL in the IEUBK Model, in accordance with the final UFP-QAPP (CH2M, 2017a). Additionally, the default maternal blood lead concentration at childbirth was updated from 1 µg/dL to 0.6 µg/dL in the IEUBK Model, as recommended by USEPA (2017b). In accordance with recent USEPA guidance (USEPA, 2017c, 2021), the default age range for children was changed from 0 to 84 months to 12 to 72 months because soil and dust ingestion rates are generally less for children aged 0 to 12 and 72 to 84 months.

Approach for Dioxins/Furans Exposures

The 2,3,7,8-tetrachorodibenzodioxin (TCDD) toxicity equivalent (TEQ) approach was used to calculate the sample concentrations and EPCs for dioxin/furan congeners, which were analyzed in groundwater samples. TEQ concentrations for the dioxin/furan congeners were calculated for each sample in accordance with the World Health Organization toxicity equivalency factor (TEF) approach (Van den Berg et al., 2006; USEPA, 2010b) to adjust the relative carcinogenic potency of specific dioxin/furan congeners, relative to TCDD, the most potent dioxin congener. Using the measured concentration values for each congener and the TEF for that congener, the dioxin TEQ concentration for a mixture of dioxin/furan congeners in a specific sample was calculated as follows.

$$\text{Dioxin TEQ Concentration} = \Sigma\,(TEF_i \times C_i)$$

where:

Dioxin TEQ Concentration = 2,3,7,8-TCDD toxicity equivalent concentration (µg/L)
TEF_i = Toxicity equivalency factor for congener "*i*" (unitless)
C_i = Concentration of congener "*i*" (µg/L)

The dioxin TEQ concentrations per sample were calculated using a proxy value of one half the DL for nondetected congeners that have been detected at least once in the data set, and a proxy value of 0 for nondetected congeners that are 100 percent nondetect.

4.3.1.4 Toxicity Assessment

The toxicity assessment describes the relationship between the magnitude of exposure to a chemical and the possible severity of adverse effects and weighs the quality of available toxicological evidence.

Where possible, this assessment provides a numerical estimate of the increased likelihood and/or severity of adverse effects associated with chemical exposure (USEPA, 1989).

The toxicity values for carcinogenicity (oral cancer slope factors [CSFs] and inhalation unit risks [IURs]), as well as for noncarcinogenic effects (oral reference doses [RfDs] and inhalation reference concentrations [RfCs]), that are used in the HHRAs were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as follows:

- Tier 1 Source—Integrated Risk Information System (USEPA, 2022c).
- Tier 2 Source—USEPA Provisional Peer-Reviewed Toxicity Values.
- Tier 3 Sources—Other peer-reviewed federal and state toxicity values, as cited in the RSL table (USEPA, 2022a). The Tier 3 toxicity value sources used in the HHRAs were identified as appropriate by the USEPA and are consistent with the USEPA's RSL User's Guide (May 2022). Priority was given to toxicity value sources that are most current, peer reviewed, transparent, and publicly available.
  - Agency for Toxic Substances and Disease Registry (ATSDR, 2022).
  - California Environmental Protection Agency toxicity database (Cal EPA, 2022).
  - USEPA's Health Effects Assessment Summary Tables (USEPA, 1997a).

The noncarcinogenic toxicity values and carcinogenic toxicity values used in the HHRAs are provided in the RAGS Part D Table 5 series and 6 series, respectively, for each site (Appendix A).

Noncarcinogenic Toxicity Values

Noncarcinogenic hazards typically are quantified by comparing intakes to oral RfDs and inhalation RfCs. The RfD is a health-based dose, expressed as a chemical intake rate in units of milligrams of chemical per kilogram body weight per day (mg/kg-day). The RfC is an allowable, health-based concentration of a chemical in air expressed in units of milligrams per cubic meter (mg/m^3). Both the RfD and RfC are based on the assumption that thresholds exist for certain toxic effects, such as liver or kidney damage, but may not exist for other toxic effects such as carcinogenicity. In general, the RfD and RfC are estimates (with uncertainty spanning perhaps an order of magnitude) of daily exposures to the human population (including sensitive subgroups) that are likely to be without an appreciable risk of deleterious effects during a lifetime of exposure (USEPA, 1989).

Noncarcinogenic toxicity values are available for both chronic and subchronic exposures. As a guideline, chronic RfDs and RfCs are used to evaluate the potential noncarcinogenic effects associated with exposure periods greater than 7 years (approximately 10 percent of a human lifetime). Chronic RfDs and RfCs are applied in the hazard calculations for the following IAAAP receptor scenarios: site worker, hunter/recreator, and hypothetical residents (child and adult). Subchronic oral RfDs and inhalation RfCs are developed specifically to be protective for short-term exposures. As a guideline, USEPA recommends that subchronic toxicity values be used to evaluate potential noncarcinogenic effects of exposure periods between 2 weeks and 7 years. For the IAAAP sites included in this RI report, subchronic RfDs and RfCs are applied in the hazard calculations to only the construction/utility worker scenario, for which a combined exposure frequency and duration is assumed to be less than 1 year.

Carcinogenic Toxicity Values

Potential carcinogenic risks were quantified using oral CSFs and IURs. The CSF is defined as a plausible upper-bound estimate of the probability of developing cancer per unit intake of a chemical over a lifetime (USEPA, 1989). In general, CSFs can be derived from the results of chronic animal bioassays, human epidemiological studies, or both. CSFs, which are expressed in units of kilogram body weight per day per milligram chemical (kg-day/mg or $[mg/kg\text{-}day]^{-1}$), were used to estimate upper-bound lifetime statistical probabilities of current and future receptors developing cancer because of exposure to COPCs in site media. The inhalation unit risk (IUR) is defined as the upper-bound ELCR estimated to result from continuous exposure to a chemical at a concentration of 1 microgram per cubic meter ($\mu g/m^3$) in air. IURs are expressed in units of cubic meter of air per microgram of chemical ($m^3/\mu g$ or $[\mu g/m^3]^{-1}$).

Derivation of Dermal Toxicity Values

Oral RfDs and CSFs were converted to dermal RfDs and CSFs using an oral-to-dermal adjustment factor. The values used for this conversion were obtained from *RAGS Part E* Section 4.2 and Exhibit 4-1 (USEPA, 2004). Following USEPA's recommendation, such a conversion was performed only when a chemical has a gastrointestinal absorption factor of less than 50 percent. If a chemical-specific adjustment factor was not available, a default value of 100 percent was used. If the gastrointestinal absorption factor was less than 50 percent, the dermal RfD was derived by multiplying the oral RfD by the gastrointestinal absorption factor as shown with the following equation:

$$\mathrm{RfD_d} = \mathrm{RfD_o} \times \mathrm{ABS_{GI}}$$

where:

RfD_d = Dermal reference dose (mg/kg-day)
RfD_o = Oral reference dose (mg/kg-day)
ABS_{GI} = Fraction of chemical absorbed in the gastrointestinal tract (unitless)

The dermal CSF was derived by dividing the oral CSF by the gastrointestinal absorption factor as shown with the following equation:

$$\mathrm{CSF_d} = \frac{\mathrm{CSF_o}}{\mathrm{ABS_{GI}}}$$

where:

CSF_d = Dermal cancer slope factor $(mg/kg\text{-}day)^{-1}$
CSF_o = Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$
ABS_{GI} = Fraction of chemical absorbed in the gastrointestinal tract (unitless)

Special Considerations

The Integrated Risk Information System oral RfD for manganese (0.14 mg/kg-day) includes manganese from all sources, including diet (USEPA, 2022c). An oral RfD for nondiet exposures was calculated by subtracting the dietary contribution from the normal U.S. diet (an upper limit of 5 mg per day) and applying a modifying factor of 3 to address uncertainties associated with nonfood manganese exposure sources and the potential for adverse neurological effects. The resulting oral "nondiet" RfD for manganese is 0.024 mg/kg-day and was used to estimate potential noncarcinogenic HQs associated with exposures to manganese in groundwater. This approach is consistent with the recommendations provided in the USEPA's (2022c) IRIS Chemical Assessment Summary for manganese and is also consistent with USEPA's (2022a) RSL User's Guide. In instances where manganese is identified as a COC, a comparison of the maximum detected concentration was made with a screening level based on the manganese recommended Dietary Reference Intakes (DRIs) (developed by the Food and Nutrition Board [FNB] at the National Academies of Sciences, Engineering, and Medicine). Screening levels calculated for an adult and child using the RDI are provided in Appendix A-1, Attachment 5. If the manganese concentrations are less than the RDI-based screening level, manganese was eliminated as a COC.

The oral RfD for vanadium (0.005 mg/kg-day) was derived from the oral RfD for vanadium pentoxide (0.009 mg/kg-day). The vanadium oral RfD was calculated by factoring out the molecular weight of the oxide ion. The two atoms of vanadium contribute 56 percent of the molecular weight for vanadium pentoxide. Therefore, the oral RfD for vanadium pentoxide was multiplied by 56 percent to calculate the oral RfD for vanadium (0.005 mg/kg-day). This calculated RfD was used to estimate potential noncarcinogenic HQs associated with exposures to vanadium in groundwater at the IAAAP sites.

The toxicity values for hexavalent chromium were used to estimate potential noncarcinogenic HQs and carcinogenic risks for total chromium due to the lack of speciated chromium data available for media at IAAAP sites. Hexavalent chromium is typically present as a fraction of the total chromium concentrations; therefore, using the hexavalent chromium toxicity values to evaluate total chromium detected in site media is a conservative approach.

Quantitative oral toxicity values are not available for lead; therefore, potential risks and hazards associated with exposures to lead for a hypothetical residential scenario were addressed using USEPA's IEUBK model (USEPA, 2010a) and USEPA's updated input parameter values, as discussed in Section 4.3.1.3.

4.3.1.5 Risk Characterization

Potential human health risks are discussed separately for noncarcinogenic and carcinogenic COPCs because of the different toxicological endpoints, relevant exposure durations, and methods used to estimate risk. The methodologies and equations used to estimate noncarcinogenic hazards and carcinogenic risks are discussed below.

Estimation of Noncarcinogenic Hazards

For the ingestion and dermal contact exposure routes, noncarcinogenic hazards were estimated by comparing the calculated intakes to RfDs. The calculated intake was divided by the RfD, as presented in the following equation. This ratio is referred to as the HQ and is expressed using one significant figure. The HQ associated with ingestion or dermal contact of noncarcinogenic COPCs is calculated as follows:

$$HQ = {}^{Intake}/_{RfD}$$

where:

HQ = unitless hazard quotient
Intake = intake level (mg/kg-day)
RfD = reference dose (mg/kg-day)

Intake and RfD are expressed in the same units (mg/kg-day) and represent the same exposure period (i.e., chronic or subchronic). An HQ that exceeds 1 (i.e., intake exceeds the RfD) indicates that there is a potential for adverse health effects associated with exposure to that COPC for that specific exposure route. Similarly, the HQ associated with the inhalation of a noncarcinogenic COPC is calculated as follows:

$$HQ = {}^{EC}/_{RfC}$$

where:

HQ = unitless hazard quotient
EC = air exposure concentration (mg/m^3)
RfC = reference concentration (mg/m^3)

An HQ that exceeds 1 (i.e., air EC exceeds the RfC) indicates that there is a potential for adverse health effects associated with exposure to that COPC for the inhalation exposure route. To assess the potential for noncarcinogenic health effects posed by exposure to multiple COPCs and exposure routes, a hazard index (HI) approach was used (USEPA, 1989). This approach assumes that noncarcinogenic hazards associated with exposure to more than one COPC and exposure route are additive. Synergistic or antagonistic interactions among COPCs are not quantified. The HI may exceed 1 even if all the individual HQs are less than 1. The COPCs were separated by similar mechanisms of toxicity and toxicological effects and separate HIs were calculated for each specific target organ, target system, or critical effect on which the RfDs or RfCs are based.

Estimation of Carcinogenic Risks

The potential for carcinogenic effects due to exposure to site media was evaluated by estimating the ELCR. The ELCR is the incremental increase in the probability of developing cancer during one's lifetime greater than the background probability of developing cancer. The linear low-dose equations were used to estimate the incremental probability of an individual developing cancer over a lifetime because of exposure to potential carcinogens.

Potential ELCRs associated with ingestion and dermal exposure to individual carcinogens were calculated using CSFs and intake estimates. The equation used to estimate the potential ELCRs is as follows:

$$ELCR = Intake \times CSF$$

where:

ELCR = unitless excess lifetime cancer risk
Intake = intake level (mg/kg-day)
CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$

Similarly, the ELCR associated with the inhalation of a carcinogenic COPC is calculated by multiplying the lifetime average EC by the IUR), as follows:

$$ELCR = EC \times IUR$$

where:

ELCR = unitless excess lifetime cancer risk
EC = air exposure concentration ($\mu g/m^3$)
IUR = inhalation unit risk $(\mu g/m^3)^{-1}$

The theoretical probability of developing cancer from exposure to two or more COPCs and by two or more exposure pathways was calculated by summing the ELCRs for each COPC.

Risk Characterization Process for IAAAP Sites Included in RI Report

This risk assessment document reflects certain procedural departures from the standard USEPA HHRA process that the Army routinely applies at its installations (USEPA, 1989). An example is the inclusion in the HHRA of onsite detected chemicals with concentrations that are either the same or less than those of their respective site-specific background concentrations (naturally occurring chemicals). Such an approach adds extraneous information into the HHRA process. The intent of COPC screening is to minimize the scope of risk assessments by eliminating chemicals that will have no bearing on risk and hazard outcomes, and per 40 Code of Federal Regulations 300.400(b)(1) CERCLA, background (naturally occurring) substances are not subject to remedial actions. The Army considers that initially computing risks and hazards for all detected chemicals only to secondarily recompute risks and hazards without the risks from the naturally occurring chemicals (background) is not useful and makes the risk assessment results confusing to the public. The knowledge of risks associated with naturally occurring chemicals does not contribute to the determination of remedial actions that may be required to address an impact from former DoD activities. Importantly, computing risks and hazards for chemicals without having first conducted background screening is not a conservative gesture. Groundwater background values were obtained from the technical memorandum *Evaluation of Background Concentrations of Metals in Groundwater, Iowa Army Ammunition Plant, Middletown, Iowa. Final* (CH2M, 2020a). This background comparison method is consistent with the UFP-QAPP (CH2M, 2017a, Worksheet #14). Although inconsistent with the process the Army uses for background in the HHRA for their installations, this method complies with the requests from the USEPA (USEPA, 2019) based on the OSWER 9285.6-07P guidance.

The risk characterization evaluations and results for the IAAAP sites included in this RI report were completed using a four-step process, as follows:

Step 1: Total Combined Risks and Hazards from Site-Related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculation of receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. These total risk estimates are only provided for informational purposes per the request of the USEPA (USEPA, 2019). No decisions for future remedial actions are based on the total risk estimates. As stated in *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988) and *RAGS Part A* (USEPA, 1989), the risk characterization should be conducted to determine the potential risks and hazards associated with site-related contamination. Naturally occurring chemicals (and the estimated risks and hazards associated with their concentrations) are not site-related contaminants. The ELCRs and HIs calculated in Step 1 are not used to determine final COCs for a site.

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculation of receptor-specific ELCRs and HIs for naturally occurring chemicals. Naturally occurring chemicals were identified using the IAAAP-specific BTVs; the comparison of metals concentrations to BTVs is provided in the nature and extent discussions for each site in Section 5. Risks and hazards associated with naturally occurring chemicals are not used to determine if remedial actions are warranted and are not considered in the determination of final COCs because they are consistent with background levels and not site-related.

Step 3: Risk Characterization of Site-related COPCs

Step 3 consists of calculation of receptor-specific ELCRs and HIs for site-related COPCs. Site-related COPCs from this step are retained for the fourth and final step of the risk characterization.

Step 4: Final COC Determination

In this final step of the risk characterization, all site-related COPCs are evaluated quantitatively and qualitatively to determine which are final COCs (and require remedial actions, such as a Feasibility Study). If no COCs are identified, the site qualifies for an NFA decision per the HHRA.

USEPA guidance generally considers an acceptable site ELCR range to be within 1 in 1,000,000 to 1 in 10,000 (1×10^{-6} to 1×10^{-4}). Generally, remedial actions are not warranted for site media with an ELCR of 1×10^{-4} or less, or an HI of 1 or less. Lead is typically identified as a COC if the predicted BLLs in more than 5 percent of the exposed population exceed the reference BLL of 10 micrograms per deciliter (µg/dL). As discussed in Section 4.3.1.3 and in accordance with the final UFP-QAPP (CH2M, 2017a), a reference BLL of 5 µg/dL was used for the HHRAs.

The final COCs were identified for a site based on the ELCRs and HIs calculated for the site-related COPCs in step 3 of the risk characterization. If an ELCR of 1×10^{-4} was exceeded for a receptor group, the COPCs posing an individual ELCR greater than 1×10^{-6} were identified as COCs. When a target organ–specific HI exceeded 1 for a receptor group, the COPCs posing an individual HQ greater than 0.1 for that target organ were identified as COCs. Groundwater COPCs for potable use and trenching scenarios that were detected at concentrations less than or equal to their respective MCLs were excluded as final COCs. Additionally, some COPCs may be excluded as final COCs based on a weight-of-evidence approach, such as a comparison of concentrations and risks and hazards based on “dissolved” and “total” metals data and a comparison of recent versus historical site concentrations.

4.3.1.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. While it is possible that this leads to underestimates of potential risk and hazards, the use of upper-bound assumptions most likely results in conservative estimates of potential risks and hazards. A receptor group’s potential exposure and subsequent potential risk and hazards are influenced by the exposure scenario and dose/response and vary on a case-by-case basis. The general uncertainties associated with the HHRAs are provided in Table 4.3-3. Site-specific uncertainties associated with each HHRA are provided in Section 5.

Typically, the first screen, applicable to all categories of chemicals (e.g., inorganic, anthropogenic, etc.) is for frequency of detection. In brief, chemicals that occur in 5 percent or less of samples for a given medium, are usually eliminated because it is evident up front, that these chemicals will play an insignificant role. In this risk assessment, no chemicals were screened out based on frequency of detection. The second screen is typically a background screen, and it would be for naturally occurring chemicals only (principally inorganic compounds, such as metals). In these risk assessments, the background screen was not done before the risk-based screening. USEPA recommends a baseline risk assessment approach that retains chemicals that exceed risk-based screening concentrations. USEPA's approach described in *Role of Background in the CERCLA Cleanup Program* (USEPA, 2002) "involves addressing site-specific background issues at the end of the risk assessment, in the risk characterization." The third screening task is risk-based screening and was completed for these sites. The maximum detected onsite concentration of a chemical was compared to the current USEPA RSL table (USEPA, 2022a), wherein the values reflect a cancer risk level of 1×10^{-6} (for carcinogens), and an HQ of 0.1 in the case of systemic toxicants.

4.3.2 Ecological Risk

This section provides the general methods used in the ERA for the OU-6 RI report. As summarized in Section 1.2.4, this RI addresses groundwater at all eight of the areas included in this report (Line 1, Line 1 Impoundment, Line 2, Line3, Line 3A, Line 5A/5B, Line 9, and Line 800 and the Pinkwater Lagoon). Discussions of the Line 1 Impoundment and Line 800 and the Pinkwater Lagoon also address surface water and sediment within Brush Creek and perennial tributaries within the Brush Creek watershed boundary. Soil is not evaluated at any of the areas, as this media was addressed under OU-1.

A screening level ecological risk assessment (SLERA) was conducted for all eight IAAAP areas included in this RI report. The purpose of the SLERA is to determine the potential for adverse ecological effects associated with exposures to site-related chemicals in environmental media in the absence of remediation. The SLERA uses conservative assumptions to screen the initial list of detected chemicals to identify those requiring further evaluation. The results of the SLERA are provided in Section 5, by site.

Several guidance documents were used to provide direction for developing the SLERA. These include, but are not limited to, the following:

- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (USEPA, 1997b).
- *Final Guidelines for Ecological Risk Assessment* (USEPA, 1998).
- *Ecological Risk Assessment and Risk Management Principles for Superfund Sites* (USEPA, 1999).
- *The Role of Screening Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments* (USEPA, 2001b).
- *Wildlife Exposure Factors Handbook* (USEPA, 1993).
- *Environmental Quality Risk Assessment Handbook, Volume II: Environmental Evaluation* (USACE, 2010).
- *Final Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa* (UFP-QAPP) (CH2M, 2017a).

In general, the approach and assumptions used in the SLERA are consistent with those provided in the final UFP-QAPP (CH2M, 2017a), with the exception of some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final UFP-QAPP (i.e., use of the more current Region 4 ESVs instead of the QAPP-approved Region 5 ESVs as the primary source of soil screening values).

The USEPA provides a formal eight-step ERA process (USEPA, 1997b, 1998), which was followed to complete the SLERAs where applicable. It bears noting that this process is readily applied for CERCLA remedial investigations independent of considerations of the size, ecological relevance, or ecological significance of contaminated sites. Often however, a site may not need an ecological assessment based on the actual site features. Additionally, the eight-step ERA process does not account for the time since a chemical release, and any reductions in toxicity due to chemical degradation or sensitivity due to generational exposure. Therefore, results of the ERA may be considered to be conservative when calculations are based on older samples.

The SLERA for the OU-6 RI followed the first two steps of the eight-step approach recommended by USEPA (1997b) as listed below:

- Step 1 of the ERA process is intended to answer two main questions: (1) Do complete exposure pathways exist? and (2) Are conservative screening levels available for the chemicals onsite to conduct the SLERA? If one or more complete exposure pathways are likely to exist, the ERA process continues to Step 2 for those pathways that have been determined to be critical. The available screening levels are then evaluated to determine whether they are adequate to evaluate the data in the SLERA. If not, additional screening levels are obtained from the scientific literature before the ERA process continues, or the ERA will be likely to move on to the refinement steps for chemicals or exposure routes lacking screening values.
- Step 2 of the ERA process involves conducting a screening exposure assessment, an effects assessment, and a risk calculation (risk characterization). The results of the SLERA are used to evaluate the potential for ecological adverse effects based upon very conservative assumptions. If the results of the SLERA suggest that further ecological evaluation or data collection is warranted, the ERA process then proceeds to the Baseline Ecological Risk Assessment (BERA) (Steps 3 through 7), which is a more-detailed phase of the ERA process, for the pathways, chemicals, receptors, and areas identified in the SLERA.

For each site in this RI, the ERA concludes at Step 1 or 2, with a conclusion of “no adverse effects to ecological receptors identified”; no site proceeded to the BERA stage. The investigation then proceeds to risk characterization (Step 7) to document this conclusion, and the ERA process terminates.

The ERA for the OU-6 RI report only addresses aquatic environments. Terrestrial environments were not evaluated in the ERA, as soil is not included in these OU-6 sites. There are perennial surface water features at two of the IAAAP areas in this RI report (Line 1 Impoundment and Line 800 and the Pinkwater Lagoon). There are no perennial surface water features within the other areas. Historically, ERAs have been conducted for various sites at IAAAP. In October 2004, a facility-wide BERA was conducted for soil, surface water, and sediment (MWH, 2004). The information available within the BERA regarding potential receptors, exposure routes, exposure factor values, and conclusions were reviewed and considered when developing the approaches and preliminary conceptual exposure models for the sites included in this RI.

4.3.2.1 Screening Level Problem Formulation (Step 1)

The screening level problem formulation establishes the goals, scope, and focus of the ERA. As part of the problem formulation, the environmental setting of the site is characterized in terms of the habitats and biota known to be or likely to be present. The types and concentrations of chemicals that are present in ecologically relevant media are also described based upon available analytical data. An ecological conceptual exposure model (ECEM) is developed that describes source areas, transport pathways and exposure media, exposure pathways and routes, and receptors. Assessment endpoints and measures are developed to evaluate those receptors for which ecologically significant exposure pathways exist.

Ecological Conceptual Exposure Model

Important components of the ECEM are the identification of potential source areas, transport pathways, exposure media, exposure pathways and routes, and receptor groups. The ECEM considered site-specific conditions that were observed at the IAAAP sites during RI field activities. Actual or potential exposures of ecological receptors associated within a particular terrestrial habitat is determined by identifying the most likely, and most important, pathways of contaminant release and transport. A complete exposure pathway has three components: (1) a source of chemicals (stressors) that results in a release to the environment, (2) a pathway of chemical transport through an environmental medium, and (3) an exposure or contact point for an ecological receptor. In the absence of any one of these components, an exposure pathway is considered incomplete, and, by definition, there is no potential for adverse effects. Key components of this ECEM are discussed in the following subsections.

Transport Pathways and Exposure Media

A transport pathway describes the mechanisms whereby site-related chemicals, once released, may be transported from a source to ecologically relevant media where receptor exposures may occur. The primary mechanisms for transport from the source areas may include the following:

- Leaching of chemicals from soil by infiltrating precipitation and transport to groundwater.
- Transport of chemicals via groundwater to sediment and surface water.
- Surface water runoff with the potential to transport particulate-bound chemicals into the respective watershed, although this transport pathway is considered relatively minor.
- Historical direct discharges.

Exposure media are the potentially contaminated media in which ecological receptors can come into contact.

Exposure Pathways and Routes

An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Exposure, and thus potential adverse effects, can occur only if a complete exposure pathway exists. An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium.

For lower-trophic-level receptors in these habitats (e.g., aquatic invertebrates), direct contact is considered the primary exposure route. Terrestrial plants may be exposed to chemicals directly from dry sediment. Lower-trophic-level receptors such as plants or aquatic biota are considered qualitatively at the community level only rather than on a species-specific basis like the representative organisms in the upper trophic categories.

Upper-trophic-level receptors (such as mammals and birds) may be exposed to chemicals through (1) the inhalation of gaseous chemicals or of chemicals adhered to particulate matter, (2) the incidental ingestion of contaminated abiotic media (soil/sediment) during feeding activities, (3) the ingestion of contaminated water, (4) the ingestion of contaminated plant and/or animal tissues for contaminants which have entered food webs, and/or (5) direct (dermal) contact with contaminated abiotic media. Exposure to chemicals present in surface water or dry sediment via dermal contact may occur but is unlikely to represent a major exposure pathway for most receptors because fur and feathers minimize transfer of chemicals across dermal tissue. In a similar manner to the dermal pathway, the inhalation pathway is unlikely to represent a major exposure pathway for terrestrial receptors.

Selection of Representative Species

To evaluate ecological exposure, representative species are selected for the functional feeding guilds identified in the ECEM. For example, a shrew may be considered representative of insectivorous mammals using the site. Consistent with *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (USEPA, 1997b), these representative species should preferably be ones that have ecological relevance, are of societal value, are susceptible to chemical stressors at the site, and allow risk managers to meet policy goals. These factors were used to select representative species common to terrestrial habitats within IAAAP. The representative species selected for each feeding guild and habitat type are as follows:

- Freshwater aquatic biota (fish, amphibians, water column invertebrates, and benthic infauna).
- Freshwater aquatic plants.
- Piscivorous birds—belted kingfisher (*Ceryle alcyon*).
- Piscivorous mammals—mink (*Mustela vison*).
- Sensitive species (utilizing riparian corridor)—Indiana bat (*Myotis sodalis*) (as a representative species for bats in general within the watershed, including the northern long-eared bat (*Myotis septentrionalis*).

Assessment Endpoints and Measures

The conclusion of the screening level problem formulation is the identification of assessment endpoints and measures. Assessment endpoints describe the valued ecological resources that are to be protected (USEPA, 1998). Assessment endpoints are selected according to their ecological relevance and their susceptibility to known or potential stressors onsite. Appropriate assessment endpoints are identified to be in line with the following management goals and objectives as stated in the IAAAP *Natural Resource Management Plan* (Stantec, 2018) and detailed in the watershed ERA (CH2M, 2022).

Measures are quantifiable and are predictive of assessment endpoints. The three categories of measures are measures of exposure, measures of ecological effects, and measures of ecosystem and receptor characteristics (USEPA, 1998). They evaluate, respectively, how exposures might occur, the response of the assessment endpoints when exposed to the stressor, and the ecosystem characteristics that might affect exposure or response to the stressor. This assessment will include both measures of exposure and measures of ecological effects. Appropriate assessment endpoints and measures include survival, growth, and reproduction. Measures, in the form of suitable screening benchmarks, are the ESVs discussed in Step 2.

4.3.2.2 Screening Level Risk Calculation (Step 2)

The following sections discuss the determination of available analytical data, ESVs, screening risk calculations, and general ERA uncertainties.

Available Analytical Data

Analytical data evaluation involved gathering and reviewing available site data and identifying a data set of acceptable quality for the SLERA. The same set of data used in the HHRA was used for the SLERA. Sediment, surface water, and groundwater samples from historical investigations and from the recent investigations conducted between 2018 and 2020, as documented in the final UFP-QAPP (CH2M, 2017a), were included in the SLERA. The historical data were evaluated to determine if they were likely to still be representative of current site conditions. The data set included in the SLERAs are discussed in Section 5.

The data were evaluated using the following procedures:

- A value qualified as "B", "D", "E", "J", or "P" was treated as a detected value.
- "U" qualified results were treated as nondetected values.
- "UJ" qualified results were treated as nondetected values, with the RL being estimated.
- "R" (rejected) qualified results were not included in the HHRA data sets.
- For sample locations where a duplicate sample or a split sample was collected, the greatest detected concentration among the original, duplicate, or split samples was used when a chemical was detected in any sample. If all results were nondetect, the lowest reported DL (that is, RL) was used.
- For nondetected results, the sample quantitation (reporting) limit (SQL) was used to represent the concentration. When calculating statistics (such as arithmetic mean), the SQL was used by ProUCL for nondetected results.

Screening Level Exposure Estimate and Risk Calculation (Step 2)

The screening level risk calculation is the final step in the SLERA. In this step, MDCs for each applicable medium at each site were compared with corresponding and conservative ESVs to derive screening risk estimates. For example, maximum medium-specific concentrations for all detected chemicals were compared to risk-based screening values without considering the fraction of time a receptor forages within a site. If ESVs were unavailable, then the chemicals were carried forward for further evaluation.

Ecological Screening Levels

The ecological SLs that were used are described in the following text; here are two possible outcomes from the comparison:

- If the maximum concentration(s) in a medium did not exceed the ESV, the chemical was not considered a chemical of potential ecological concern (COPEC).
- If no ESV was available, the chemical was selected conservatively as a COPEC depending upon rationale and potential former use.

The ESVs followed the following hierarchy:

- USEPA Region 4 ESVs (USEPA, 2018b).
- USEPA Region 5 Ecological SLs (USEPA, 2003a).

In the approved UFP-QAPP, USEPA Region 5 ESVs were selected. However, Region 4 values were used as the primary source since they are more current.

Recommendation for Scientific Management Decision Point 1

Following Step 2, the first scientific management decision point occurs. This scientific management decision point is intended to communicate the findings of the SLERA and to determine which COPECs, representative species, and exposure pathways should be carried forward to Step 3.

SECTION 5

Site-Specific Remedial Investigation

This section summarizes site-specific background information and site physical characteristics, RI activities, and investigation results for 10 IAAAP sites within 8 areas (Line 1, Line 1 Impoundment, Line 2, Line 3, Line 3A, Lines 5A/5B, Line 9, and Line 800 and Pinkwater Lagoon; see Section 1.2.4). Each site-specific section begins on a new page and is followed by its tables and figures.

The media addressed in this OU-6 RI at each of the 10 IAAP sites in the 8 areas is summarized as follows:

- **Line 1 Ammo LAP (Load, Assemble, and Pack) (CC-001G):** This RI report addresses groundwater at Line 1 (CC-001G). Soil at Line 1 (IAAP-001) is addressed under the remedy for OU-1 (Leidos, 2018), and structures at Line 1 are addressed under the remedy for OU-8 (USACE, 2019b). There are no perennial surface water features within the Line 1 site boundary; therefore, no aquatic receptors were evaluated, and human health receptors were not evaluated for exposure to sediment or surface water at this site.
- **Line 1 Former Wastewater Impoundment (IAAP-016 and IAAP-016G):** This RI report addresses soil (IAAP-016) and groundwater, surface water, and sediment (IAAP-016G) at the Line 1 Impoundment.
- **Line 2 Ammo LAP (IAAP-002G):** This RI report addresses groundwater at Line 2 (LAP)–Groundwater (IAAP-002G). Soil is addressed under the remedy for OU-1 (Site IAAP-002) (Leidos, 2018). There are no perennial surface water features within the Line 2 site boundary.
- **Line 3 Ammo LAP (IAAP-003G):** This RI report addresses groundwater at Line 3 (IAAP-003G). Soil is addressed under the remedy for OU-1 (IAAP-003) (Leidos, 2018). There are no perennial surface water features within the Line 3 boundary.
- **Line 3A Ammo LAP (IAAP-004G):** This RI report addresses groundwater at Line 3A (IAAP-004G). Soil is addressed under the remedy for OU-1 (IAAP-004) (Leidos, 2018). There are no perennial surface water features within the Line 3A site boundary.
- **Lines 5A and 5B Ammo Assembly (IAAP-006G):** This RI report addresses groundwater at Lines 5A/5B (IAAP-006G). Soil is addressed under the remedy for OU-1 (IAAP-006) (Leidos, 2018). There are no perennial surface water features within the Lines 5A/5B boundary.
- **Line 9 Ammo LAP (IAAP-010G):** This RI report addresses groundwater at Line 9 (IAAP-010G). Soil is addressed under the remedy for OU-1 (IAAP-010) (Leidos, 2018). There are no perennial surface water features within the Line 9 boundary.
- **Line 800 and Pinkwater Lagoon (IAAP-044 and IAAP-044G):** This RI report addresses soil at Pinkwater Lagoon (IAAP-044), groundwater at Line 800 and Pinkwater Lagoon (IAAP-044G), and surface water and sediment at Pinkwater Lagoon (IAAP-044G). Soil within the Line 800 portion of the site (IAAP-011) is addressed under the remedy for OU-1 (Leidos, 2018). There are no other perennial surface water features within the Line 800 site boundary.

In accordance with the final UFP-QAPP (CH2M, 2017a), screening values used for site characterization differ from those that used in the risk assessments. The site characterization PALs were used to assess the distribution and nature and extent of chemicals whereas more conservative screening values will be used for risk assessment. The site characterization PALs are discussed in Section 4.1.1.

5.1 CC-001G_Line 1 Groundwater Line 1 (19105.1065)

This subsection summarizes RI activities at Line 1. This report documents the RI for groundwater at Line 1 (CC-001G). Soil for Line 1 (IAAP-001) is addressed under the remedy for OU-1 (Leidos, 2018), and structures at Line 1 are addressed under the remedy for OU-8 (USACE, 2019b). There are no perennial surface water features within the Line 1 site boundary; therefore, no aquatic receptors were evaluated, and human health receptors were not evaluated for exposure to sediment or surface water at this site.

5.1.1 Background

5.1.1.1 Site Description

Line 1, approximately 1 mile long and encompassing 231 acres, is located in the northeastern quadrant of the IAAAP and is immediately east of Brush Creek (Figure 5.1-1). It historically contained more than 200 buildings and associated facilities; several of the buildings have been recently demolished or are scheduled for demolition as part of IAAAP's facility demolition plan (IAAAP, 2023). Line 1 has functioned as an LAP facility for cartridges, missile warheads, and grenades (JAYCOR, 1996); only a portion of the site is currently active. Line 1 is contiguous with the Line 1 Impoundment (IAAP-016 and IAAP-016G), which is discussed in Section 5.2. Several new facilities are planned for construction at Line 1.

5.1.1.2 Operational History

Ammunition (shells) with an amatol mixture was produced at Line 1 from 1941 until August 1945. The mixture was prepared by melting solid TNT and incorporating ammonium nitrate; the shells were made by pouring the melted mixture into molds. The TNT was transferred via covered monorail conveyor to Building 1-50 for screening (Figure 5.1-1). Ammonium nitrate and TNT were transferred via conveyor to melt Buildings 1-05-1 and 1-05-2; melting occurred on the second floor and pouring into molds and cooling of the shells occurred on the first floor. The hardened shells were transferred from the east sides of Buildings 1-05-1 and 1-05-2 via conveyor for drilling and boostering at Building 1-10, then transferred via conveyor to Building 1-12 for assembly and shipping. Building 1-05-1 was destroyed by an explosion in December 1941, with Building 1-05-2 continuing to operate until the rebuilding of Building 1-05-1 was completed (presumably in 1942). Excess TNT that crystallized on the outside of the shells accumulated on the floors of the process buildings, which were steam cleaned daily. After production ceased at Line 1 in 1945, buildings were washed down with hot water, steam, and unknown solvents, where necessary (TN & Associates, 2001). The Preliminary Assessment noted that metal-cleaning operations were also once performed at this line (JAYCOR, 1994a). Per the 1990 FFA, chromic acid could be used during metal-cleaning activities at the IAAAP.

Production at Line 1 resumed in 1948 under the control of the Atomic Energy Commission (AEC) to fabricate explosive components for nuclear weapons. Building 1-08-2 (high-explosive magazine) was renovated into a ready magazine and was renamed Building 1-60 (barium nitrate preparation). In 1952, the AEC expanded Line 1 as follows: Building 1-100 was added; Building 1-70 was added along with upgrades to the wastewater conveyance system; and Building 1-40, the 1-63 series of buildings, and other buildings were added to the east. The AEC produced castings composed of baratol (a mixture of barium nitrate and TNT), boracitol (boric acid and TNT), and cyclotol (a mixture of RDX and TNT, also known as Composition B) (USACE, 2019b). As with amatol production, the production process was conducted at melt Buildings 1-05-1 and 1-05-2 and involved melting TNT, incorporating barium nitrate, pouring the mixture into molds, and cooling the castings. Ortho- and para-nitrotoluene (also known as 2- and 4-nitrotoluene), and later anthracene, were used as anticracking agents during the melt process. Buildings 1-10, 1-12, and 1-40 were used for machining (TN & Associates, 2001), which required coolant water. Other support buildings for this process were 1-04 (Baratol Lab); 1-03 (sample casting preparation and crusher building); 1-06-01, 1-06-02, and 1-08-01 (TNT Storage and Preparation Buildings); 1-50 (TNT inspection and Transfer); and 1-71, 1-72, 1-74, 1-75, and 1-76 (Explosive

Components Rest Houses). According to TN & Associates (2001), the daily steam cleanings continued under the AEC, and the same magazine buildings were used for storing the explosive and nonexplosive components for the melt/pour process. During the AEC production, trichloroethene (TCE) and acetone were used for cleaning purposes, primarily in the gauge maintenance shop in Building 1-01, with 1,1,1 trichloroethane (TCA) replacing them in 1954 (TN & Associates, 2001). Building 1-73 was initially used as an X-ray building for completed components to find flaws and to collect data needed to make improvements before it was replaced by the larger Building 1-100 (TN & Associates, 2001). Building 1-53 was used as the IAAAP plastics laboratory (USATHAMA, 1980).

The AEC operated Line 1 until 1975, when operations returned to Army control. Under the Army, 155-millimeter (mm) rounds (later moved to Line 3), grenades, and a variety of warheads were produced. Current production of ordnance occurs in the southwest portion of Line 1. Other buildings are either used for storage or are not used. Several buildings were recently demolished (Figure 5.1-1). The amount and location of munitions production and testing fluctuates based on evolving mission needs.

5.1.1.3 Line 1 Wastewater and Non–Process Water Discharges

From 1941 through 1945, the wastewater resulting from the daily steam cleaning of buildings flowed outside the doorways, directly into drainage ditches (TN & Associates, 2001), and via aboveground concrete gutters/troughs to nearby ditches that ultimately transported the wastewater into Brush Creek. Figure 5.1-2 shows historical discharge flow paths at Line 1. Gutter/trough discharges from Buildings 1-05-1 and 1-05-2 were from the northwest and southwest corners of the buildings, along the covered monorail conveyors, and into the branches of a bifurcated, ephemeral drainage west of the buildings (Figure 5.1-2); the north branch extended more northerly and received flow from the northwest corner of Building 1-05-2. Much of this drainage is still present and is referred to as the north-central ephemeral ditch (NCED) (Figure 5.1-2). Discharges from the northwest corner of Building 1-05-2 may have also been to a northwesterly trending ditch northwest of the building (Figure 5.1-1).

Discharges from Buildings 1-10 and 1-12 were to the “Redwater Ditch,” which flowed north along the west side of Building 1-12 then due west near the southwest corner of Building 1-10; much of the drainage is still present and referred to as the south-central ephemeral ditch (SCED) (Figure 5.1-2). During postproduction building washdowns in 1945, the resulting wastewater may have been discharged in a similar manner.

During the AEC operations (after 1948), wastewater from Buildings 1-05-1, 1-05-2, 1-10, and 1-12 was reportedly collected in clarifiers to settle the heavy particulate matter, then discharged via concrete troughs or underground pipes (historical drawings show both). According to the *Final Comprehensive (Brush Creek, Spring Creek, Long Creek, and Skunk River) Watersheds Evaluation and Supplemental Data Collection Work Plan* (final CWWP) (Tetra Tech, 2006b), continuous operation and wastewater may have been a source of contamination at Line 1.

In 1962, a contaminated water collection system was constructed to collect and transfer treated wastewater along an underground piping system from Buildings 1-70, 1-70-1, and 1-40 to the downstream end of the SCED near its confluence with Brush Creek (Tetra Tech, 2014a). The wastewater was transferred to treatment tanks and treated by carbon adsorption in filter houses, and then effluent was discharged to drainage ditches and flowed via NPDES-permitted outfalls to Brush Creek (JAYCOR, 1996). NPDES discharge #11 was located at the conjunction of the SCED and Brush Creek, and NPDES discharge #12 was located at the conjunction of the NCED and Brush Creek. Building 1-70-1 was also constructed at this time to filter untreated wastewater transported via aboveground piping from Building 1-05-2. Available drawings indicate that Building 1-05-1, which may have still been on layaway status (since 1954), did not discharge into the system. Aboveground piping continued to transport untreated wastewater from Buildings 1-100, 1-10, and 1-12 to Building 1-70. Activated carbon was added to the filtration process at Buildings 1-70, 1-70-1, and 1-40 in approximately 1966, and recirculation of wastewater at Building 1-05-2 was added in approximately 1977, further reducing the amount of contaminated water discharged from Line 1 (Tetra Tech, 2014a).

Discharge of process wastewater to the NPDES outfalls stopped after July 1977; these outfalls are not included in the 2020 NPDES permit (Section 1.2.2). A minimal amount of wastewater is generated at Building 1-19, located in the southwest portion of Line 1, and transported to the carbon filter systems at Line 3 for treatment (U.S. Army, 2011).

Although not considered wastewater, nonprocess water, which was dewatered from former subterranean Building 1-40, was previously discharged through a short section of the contaminated water collection system piping into a ditch southwest of the building, which flowed into the NCED (Tetra Tech, 2014a). Building 1-40 was recently demolished.

Nonprocess water from sumps in the subterranean portions of Buildings 1-63-1 through 1-63-6 is treated via carbon filtration then discharged to the IAAAP sanitary sewer. These filters are monitored routinely for compliance (Tetra Tech, 2011b). The water from three of the locations, Buildings 1-63-3, 1-63-4, and 1-63-5, has periodically contained detectable concentrations of explosives, with Building 1-63-3 typically containing the greatest and most frequent detections. Water from these subterranean buildings is suspected to be infiltrated groundwater (Tetra Tech, 2011b).

5.1.1.4 Previous Investigations and Remedial Actions

Numerous investigations have been conducted at IAAAP since the 1980s. Table 5.1-1 summarizes the previous investigations and remedial actions conducted at Line 1, including conclusions and recommendations. Previous investigations for Line 1 were often conducted at the adjacent Line 1 Impoundment; therefore, investigations of the former impoundment are also included in Table 5.1-1 to provide a more comprehensive view of the site history. Although soil at Line 1 has already been addressed under OU-1, previous investigations for soil are also presented in Table 5.1-1 to support the CSM. Similarly, intermittent surface water and sediment samples collected at Line 1 are also included in Table 5.1-1 as they are part of the previous investigations in these areas.

This report summarizes the RI for groundwater at Line 1 (CC-001G). Previous investigations pertinent to the RI for this IAAAP site are listed in Table 5.1-2; additional details on these investigations (e.g., a more-detailed description of work completed as well as work not pertinent to this RI) are listed in Table 5.1-1. Previous sample locations are shown on Figure 5.1-3.

Table 5.1-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	Releases of TNT, lead azide, barium nitrate, mercury fulminate, PBX, and antimony sulfate to the environment may have occurred during historical site operations at Line 1. Sampling was recommended around the buildings known to generate or treat hazardous wastes to determine whether past discharges, spills, and leaks persist in the environment.
Facility-wide Site Inspection (JAYCOR, 1992)	No groundwater samples were collected during the facility-wide site inspection from Line 1. It was recommended that Line 1 be included in the RI.

Table 5.1-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Phase I and Follow-on RI (JAYCOR, 1993a, 1996)	Surface water, sediment, and groundwater samples were collected from Line 1; samples were analyzed for explosives, VOCs, SVOCs, metals, pesticides, PCBs, and/or radionuclides. Localized metals (lead, chromium, and silver) and explosives (RDX, HMX, TNT, 1,3,5-TNB, 2,6-DNT) were detected in sediment and surface water at NPDES discharges, associated drainageways, and sumps. In groundwater, metals and explosives were detected in numerous samples, while VOC detects were less prevalent. The lateral extent of groundwater contamination was limited to the south/southeast side of the melt buildings. The RI recommended semiannual groundwater monitoring at Line 1 for explosives and metals for compliance with the hazardous waste management regulations for permitted facilities.
Periodic Groundwater and Surface Water Monitoring (multiple reports)	Groundwater samples were collected from Line 1 during multiple sampling events between 1994 and 2008 and analyzed for explosives and metals. Samples were occasionally analyzed for radionuclides. Both explosives and metals were detected in samples, but groundwater plumes were generally stable, and evidence of biological degradation was noted. Neither gross alpha nor gross beta exceeded SLs when last analyzed in 2006.
Supplemental RI (MWH, 2004)	Groundwater samples were collected from two DPT borings at Line 1 and analyzed for VOCs and select SVOCs. Toluene and substituted benzene compounds were detected in groundwater samples, along with trace levels of 1,1-DCA, 1,1-DCE, and cis-1,2-DCE.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	The work plan noted that Investigation of groundwater and surface water interactions would take place as part of the Brush Creek Surface Water and Sediment Investigation Work Plan for OU-4 and investigation of groundwater data gaps would also occur as part of a facility-wide work plan.
Presupplemental RI Sampling (Tetra Tech, 2014a)	Groundwater samples were collected from two DPT borings at Line 1 and analyzed for explosives. Several explosives were detected in the DPT groundwater samples collected adjacent to and downgradient from Building 1-70.
DPT Investigation (USACE, 2011b)	Seven groundwater samples were collected from temporary borings as part of a FUSRAP investigation of the waste lines that ran from Buildings 1-100, 1-10, and 1-12 to Building 1-70. Samples were analyzed for explosives in 2010 and 2011. Four explosives (RDX, HMX, TNT, and 1,3,5-TNB) were detected. RDX was the most frequently detected and greatest-concentration contaminant.
Phase I, Phase II, and Phase III SRI (Tetra Tech, 2012a, 2014a, 2014b)	Groundwater samples were collected from temporary wells and permanent monitoring wells at Line 1. Samples were analyzed for explosives and/or metals. Although several explosives are present in site media, RDX is the primary contaminant. The RI concluded that the RDX groundwater plumes were adequately delineated and that further vertical migration is limited by the low-permeability till geology.

DCA = dichloroethane

DCE = dichloroethene

PBX = plastic bonded explosive

SVOC = semivolatile organic compound

TNB = trinitrobenzene

Based on the results of previous investigations, several remedial actions have been implemented at Line 1 (Table 5.1-1).

As part of the previous investigations under OU-1, explosives (primarily RDX and TNT), metals (predominately lead), SVOCs (primarily PAHs), and PCBs were identified as soil COCs for Line 1 (USACE, 2019b). Elevated concentrations of RDX and TNT at Line 1 were identified near Buildings 1-05-1, 1-05-2, 1-08-1, 1-10, and 1-12 during previous investigations. The greatest concentrations were observed in surface soil adjacent to Building 1-12 and in the earthen floor of the former Building 1-05-1 basement. In general, the greatest concentrations were in the upper 2 feet of soil, with concentrations decreasing with depth. The only compound that was identified at depths potentially intersecting the water table was RDX (CH2M, 2017b). Some metals (arsenic, lead, barium, and silver) and indeno(1,2,3-cd)pyrene also were detected at levels greater than the OU-1 remedial goals (RGs) in drainages and around doorways of buildings at Line 1 during the 1991–1992 RI field efforts; however, many of the greatest concentrations for these chemicals were removed as part of the sump excavations that were later completed (Tetra Tech, 2006b).

In accordance with the OU-1 ROD (Harza, 1998), soil removals have been conducted at Line 1 (Table 5.1-1). Building structures have also been decontaminated at Line 1 under FUSRAP; two buildings (1-40 and 1-70) at Line 1 that were sources of contamination have been demolished and soils were addressed under OU-1. Line 1 structures are addressed under OU-8 (USACE, 2020). Line 1 is also subject to OU-1 LUCs (Leidos, 2019). Figure 5.1-1 shows the areas where soil removal has occurred (USEPA, 1998a, 1998b). Although several removal actions have been completed at Line 1, not all soil with chemical concentrations greater than the OU-1 RGs could be removed from five exposure units (EUs) due to access restrictions (such as the presence of buildings or other structures). RDX concentrations greater than human health RGs were not removed in EU7-E (Buildings 1-12 and 1-82-3) or EU9B-B (Building 1-70). RDX concentrations greater than leaching RGs were not removed at EU5-E (terminated below groundwater table), EU6-A (blast berm), or EU7-D (steam pipe foundation). Inaccessible areas where contaminated soil was left in place at Line 1 are detailed in the final *FUSRAP Five-Year Review Report for Operable Unit 1 (OU-1) and Operable Unit 8 (OU-8), Iowa Army Ammunition Plant* (USACE, 2019b). Note that RDX and TNT soil RGs are based on leachability protection levels. Because soil was remediated to its leachability goals for RDX and TNT, the sources to groundwater in the removal areas have been addressed. FUSRAP is responsible for the soil work at Line 1 and continues to investigate potential sources under their Pre-Design Investigation Work Plans for Line 1.

5.1.2 2018–2020 Remedial Investigation Activities

Additional field work was conducted at Line 1 to resolve data gaps needed to complete the RI for groundwater (CC-IAAP-001G). As documented in the final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 1)* UFP-QAPP (CH2M, 2017b), RDX in groundwater was not adequately characterized at the sites, and neither the presence nor absence of TCE potentially released from Building 1-01 was established. To address this data gap, six permanent overburden monitoring wells (L1-MW102 through L1-MW107) were installed throughout the area (Figure 5.1-3). The six new monitoring wells and seven existing monitoring wells were sampled for explosives. Additionally, new well L1-MW107 was sampled for VOCs, SVOCs, and naphthalene. Fieldwork completed at Line 1 was conducted in accordance with the UFP-QAPP (CH2M, 2017a).

Between April 10 and June 22, 2018, six monitoring wells (L1-MW102 through L1-MW107) were drilled and installed at Line 1 with the following data objectives:

- L1-MW103 was installed upgradient and L1-MW102 was installed downgradient of the south RDX plume to delineate the horizontal extent of RDX in overburden groundwater.
- L1-MW104 was installed south of the northern RDX plume to improve delineation and evaluate the downgradient extent of elevated concentrations reported at previous sample location IAAP-135732.
- L1-MW105 was installed upgradient of the greater-concentration plume area near Building 1-40.
- L1-MW106 was installed upgradient of the plume at L1-MW-UNK1.

- L1-MW107 was installed to evaluate the northern extent of RDX contamination at Building 1-03 and presence or absence of TCE downgradient of Building 1-01.

Monitoring well locations were drilled using a combined DPT/HSA drill rig until the water table was encountered at 20 to 30 feet bgs (Figure 5.1-3). At each boring, continuous soil samples were collected to depth and logged for lithologic characterization. Boring logs are provided in Appendix C. Following initial sampling, boreholes were reamed with 8-inch-outer-diameter augers to the identified well depth. Each monitoring well was completed with a 2-inch-nominal-diameter Schedule 40 PVC screen and riser. Monitoring wells were screened across the saturated interval from 15 to 25 feet bgs at L1-MW102, L1-MW104, L1-MW105, and L1-MW107; from 20 to 30 feet bgs at L1-MW103; and from 10 to 20 feet bgs at L1-MW106. The wells were constructed with a certified-clean 20/40 silica sand filter pack from the base of the borehole to 2 feet above the top of the screen. A bentonite seal (2 to 3 feet thick) was placed to 1 foot bgs above the filter pack sand and hydrated. A cement grout was placed above the bentonite seal and wells were completed with either flush mount or aboveground (stick-up) monuments with a locking steel well vault. Three bollards were installed around each well pad. Well completion diagrams are provided in Appendix C. Table 5.1-3 summarizes the monitoring well construction details for the new monitoring wells.

Newly installed monitoring wells were developed between July 10 and 12, 2018. Monitoring wells were developed through a series of surging and pumping. At least one set of groundwater quality parameters (pH, temperature, turbidity, and specific conductivity) were collected during development. Due to low recharge rates, each well was developed until it ran dry and allowed to recharge before developing until dry again. Well development logs are included in Appendix C.

Seven existing monitoring wells (JAW-40 through JAW-42, JAW-47, JAW-52, L1-TTMW-100, and L1-TTMW-101) and five of the six new monitoring wells (L1-MW102 and LI-MW104 through L1-MW107) were sampled via low-flow purging and sampling techniques (with a peristaltic pump) between November 14 and November 16, 2018. Because monitoring well L1-MW103 was frozen in November 2018, it could not be sampled at that time. Therefore, it was sampled on March 25, 2019. Prior to initiating sampling, a sitewide water-level survey was completed (Table 5.1-4). Groundwater samples were shipped to an offsite laboratory for analysis of explosives by Method SW8330A; monitoring well L1-MW107 also was sampled for VOCs by Method SW8260B. Purge logs are included in Appendix C. Data were managed and validated as discussed in Section 3.3. Laboratory reports are provided in Appendix B.

All IDW generated during activities (soil and purge water) was disposed of in accordance with management activities discussed in Section 3.2.9. Waste management documentation is provided in Appendix D.

The six newly installed monitoring wells and one existing monitoring well (L1-MW-UNW2) were surveyed in 2018 and 2019, respectively, by Bruner, Cooper, and Zuck, Inc., licensed Iowa surveyors, in accordance with Section 3.2.8. The existing well was resurveyed due to a lack of top-of-casing elevation data. Survey information is included in Appendix E.

5.1.3 Environmental Setting

5.1.3.1 Topography and Surface Water

The topography at Line 1 is relatively flat, sloping slightly to the west-southwest, with surface elevations ranging from 719 feet amsl in the north to 705 feet amsl in the south. There are no perennial streams, creeks, or ponds at Line 1. Drainage ditch water at Line 1 occurs in unlined drainages (sometimes referred to as tributaries or drainage ditches) (Figure 5.1-1). Multiple field observations during the phased Supplemental Remedial Investigation (SRI) (Tetra Tech, 2012a, 2014a, 2014b) confirmed that the NCED, SCED, and other drainages at Line 1 are ephemeral. A site reconnaissance of the drainage network was conducted in 2019 as part of a bioreactor treatability study (CH2M, 2019b). Surface water conveyance lines and ditches that discharge to the northern and southern tributaries were inspected for connection, flow, and observable water quality. The following observations were made:

- Only one outfall is present at the northern tributary (NCED); flow is derived from surface water runoff, and no other drainage line sources were observed. Surface water flow to the northern tributary outfall is derived from two distinct channels, which connect at a culvert approximately 125 feet east of the railroad tracks. Water then flows through a series of culverts under the railroad tracks and the access road before being discharged at the sole tributary outfall location approximately 60 feet west of the access road.
- Surface water flow to the southern tributary (SCED) is via two separate outfalls. Flow from the first outfall is derived from surface water runoff, similar to that observed for the northern tributary. Surface water is conveyed from this ditch through culverts underneath the railroad tracks and access road and then outfalls to the southern portion of the south tributary approximately 60 feet west of the road. A second outfall relays flow from three drainage lines formerly connected to the sumps in Buildings 1-40, 1-70, and 1-70-1. A minimal amount of surface water was observed flowing in each of the sump drainage network conveyance lines, even though this system is no longer connected to active sumps.

Brush Creek lies immediately west of Line 1 and receives surface drainage from Line 1, particularly from the NCED and SCED. Brush Creek flows past other production lines south of Line 1 and exits the facility at the south boundary, approximately 3.7 miles from the south end of Line 1.

5.1.3.2 Geology and Hydrogeology

Because Line 1 and the Line 1 Impoundment are contiguous, the geology and hydrogeology of these areas are discussed together. A cross section is provided in Figure 5.1-4. The Line 1 Impoundment is discussed in more detail in Section 5.2.

Geology

In the Line 1 area, fill material up to 5 feet thick comprising clay, silt, and sand was observed. According to interviews with retirees from IAAAP, Line 1 was built on a marshy area, and some of the buildings required fill material before being constructed (U.S. Army, 2011). This is supported by historical photographs, aerials, and building drawings. Buildings were reportedly constructed over drainages that had to be rerouted around the building or culverted beneath the building. Later construction required fill over a portion of the SCED/Redwater Ditch (Building 1-70), and over the upstream end of at least two ephemeral drainages. To construct the former Line 1 Impoundment, fill composed of dark brown to black sandy silt/clayey silt containing coal fragments was used. The fill can be distinguished from the natural soil, which is lighter in color (TN & Associates, 2001).

The overburden soil at Line 1 consists primarily of loess (approximately 5 to 10 feet thick), alluvium (up to 7 feet thick), and till (approximately 50 to 90 feet thick at the site) that is underlain by bedrock composed of limestone and shale (Figure 2-7). The predominant lithology of the overburden is clay (sometimes silty and sandy) and silt with discontinuous localized layers of sand or sand and gravel. Bedrock is encountered from 55 to 93 feet bgs. Till and loess thins laterally to the west and are generally absent along Brush Creek. Soil boring logs for the new monitoring wells installed in 2018 are consistent with previously interpreted geology at the site. Logs showed predominantly lean clay with varying amounts of sand to logging depth, which ranged from 20 to 25 feet bgs (Appendix C).

At Brush Creek, the lithology is alluvium underlain by glacial till. The till is composed of generally homogeneous lean to sandy clay with varying quantities of sand/gravel in discontinuous, localized seams that are typically less than 1 inch thick. The unconsolidated overburden is underlain by bedrock composed of limestone and shale, which was encountered from 55 to 93 feet bgs at JAW-601. The sand fraction coarsens with depth, and the till becomes denser.

Hydrogeology

Groundwater levels in the overburden at Line 1 and the former impoundment vary from artesian conditions near Brush Creek to water table conditions (approximately 10 feet bgs) at Line 1. During the 2018 RI field activities, water levels ranged from 3.37 to 9.33 feet bgs (Table 5.1-4). Figure 5.1-5 presents the November 2018 potentiometric surface map at the sites. The direction of overburden groundwater flow in the area is generally toward Brush Creek. However, the potentiometric surface at Line 1 is influenced by several features including pumping and discharge of water from subterranean buildings, the south branch of the NCED and/or the storm sewer in its vicinity, and the SCED.

Horizontal gradients in the overburden measured in August 2018 ranged between 0.016 foot per foot (ft/ft) between L1-MW106 and JAW-42 and 0.022 ft/ft between L1-MW107 and JAW-38 at Line 1. The horizontal gradient in the overburden measured between JAW-44 and SL-81R at the Line 1 Impoundment in August 2018 was 0.055 ft/ft. In bedrock, groundwater flows to the south-southwest (Tetra Tech, 2006b) based on historical, facility-wide gauging events. The horizontal gradient in bedrock groundwater historically ranges from 0.0022 to 0.017 ft/ft. Vertical gradients between overburden and bedrock groundwater are downward at wells JAW-51/JAW-603 and JAW-50/JAW-602; well locations are shown on Figure 5.1-5.

Hydraulic conductivity (*K*) testing has not been conducted at Line 1. At the Line 1 Impoundment, slug testing was conducted at one well (G-14; see Figure 5.1-3), which resulted in an estimated *K* value in the till of 2.43 feet/day. The generally high *K* value may be a result of more-permeable lenses of sand encountered in the borehole between 27 and 38 feet bgs. Well G-14 may not reflect a representative *K* value for the till because the top of the filter pack is at 8 feet bgs, whereas the top of the screen is at 26 feet bgs. For comparison, *K* values calculated in other wells screened in till and till combinations at IAAAP resulted in an average of 0.64 foot/day, as discussed in Section 2.6. At the adjacent Line 2, *K* values were calculated from slug tests and ranged from 0.00035 to 2.5 feet per day in the overburden (Tetra Tech, 2012b).

Subterranean Structures

Interaction between groundwater and the subterranean portion of structures has been observed at former Building 1-70, former Building 1-40 and associated structures, and Buildings 1-63-1 through 1-63-6 at Line 1 (Figure 5.1-1). The accumulated water at these subterranean buildings is not considered wastewater and is believed to be a combination of rainwater and groundwater. Other Line 1 buildings with deep basements (for example, former Buildings 1-05-1 and 1 05-2) may have accumulated rainwater or groundwater, but were not known to discharge water to the surface.

Former Buildings 1-70 and Building 1-40 were recently demolished. However, historical dewatering of these buildings may have facilitated the transport of contamination at Line 1 and help explain the extent of the current groundwater plumes. Therefore, a discussion of these subterranean buildings, along with existing Buildings 1-63-1 through 1-63-6, is provided. Buildings 1-40 and 1-70 had trench drain systems beneath and surrounding them (from 1 to 2 feet bgs to below the structures), which would allow for faster infiltration of rainwater and a mounding of the groundwater surface at times of heavy rainfall. Additional details about each building follows:

- **Building 1-40.** Accumulated water at Building 1-40 was collected in a sub-basement/sump and pumped out to a ditch via an external sump/catchment basin, which flows into the NCED. The groundwater potentiometric surface near Building 1-40 was previously drawn down by dewatering activities. Water discharge at Building 1-40 occurred only after rainfall, possibly indicating that the bulk of the water being pumped was rainwater that had infiltrated into the trench drain system.

- **Building 1-70.** Dewatering activities did not occur at Building 1-70, where groundwater elevations were approximately 5 feet above the floor of the basement and water was believed to be primarily rainwater with minor infiltration of groundwater into the trench drain system. Seepage of Building 1-70 water (whether rainwater or possibly groundwater) into the SCED was not observed.
- **Building 1-63 series.** Water infiltrating the 1-63 series buildings is captured in sumps and is pumped through a water treatment system into the sanitary sewer by the Army's operating contractor.

5.1.3.3 Groundwater/Drainage Ditch Water Interaction

By comparing surface topography and elevations in drainage bottoms to overburden groundwater elevations, groundwater appears to have the potential to discharge to the NCED west of former Building 1-05-1 and SCED west of Building 1-10 (Figure 5.1-2). However, groundwater has not been observed to discharge along these drainages. Multiple field observations during the phased SRI (Tetra Tech, 2012a, 2014a, 2014b) confirmed that the NCED, SCED, and other drainages at Line 1 are ephemeral. Drainages contain water only after rainfall events large enough to produce runoff and act as stormwater conveyances.

As part of the 2019 site reconnaissance for the bioreactor treatability study (CH2M, 2019b), surface water samples were collected from manholes or drainage ditches and compared to nearby groundwater data (from monitoring wells L1-TTMW-101, L1-MW104, and JAW-41) to evaluate whether groundwater may be discharging to surface water along the drainage network. Based on the groundwater assessment, infiltration of groundwater into the surface drainage lines may be contributing to the increasing flow and may influence the decreasing RDX concentrations as the line approaches the south tributary.

5.1.4 Nature and Extent of Contamination

This subsection describes the nature and extent of contamination at Line 1. Soil has been addressed under OU-1; however, soil is discussed briefly to inform the CSM for potential groundwater contaminant sources. Groundwater samples have been collected from all areas identified as potential source of contamination to date; these groundwater samples reflect contributions from previous soil sources. No perennial surface water or sediment is present at Line 1.

Potential sources of contamination at Line 1 include historical activities associated with explosives-related processing, assembly, and shipping at various buildings within Line 1, and wastewater treatment at Building 1-70. The major feedstocks historically used at Line 1 included TNT, lead azide, barium nitrate, mercury fulminate, PBX, and antimony sulfate (JAYCOR, 1994a). Metal-cleaning operations were also once performed at Line 1, (JAYCOR, 1994a). Primary release points/mechanisms include former wastewater sumps and/or clarifiers at former Buildings 1-05-1, 1-05-2, and 1-08-1 and existing Buildings 1-12 and 1-10; wastewater troughs/discharge points from former Buildings 1-05-1 and 1-05-2; wastewater discharges and spills, and rainwater/groundwater pumping from former subterranean Building 1-40. Active discharges at Line 1 ceased in 1997.

5.1.4.1 Groundwater

Groundwater samples have been collected at Line 1 as part of several investigations between 1981 and 2019. Twenty-four monitoring wells are present at Line 1. Twenty-two of the wells are screened in the overburden to depths ranging from 10 to 50.4 feet bgs, and two are screened in the bedrock to depths ranging from 67 to 97.5 feet bgs (Figure 5.1-5). Historical groundwater samples were analyzed for analyzed for VOCs, SVOCs, explosives, metals, PCBs, pesticides, herbicides, and radionuclides. No herbicides, pesticides, or PCBs were detected in historical groundwater samples. Based on historical site operations and COCs identified in soil, explosives and metals are considered chemicals of interest in groundwater at Line 1. RDX is the most extensive contaminant in groundwater; the extent of RDX concentrations greater than the site characterization PAL of 2 µg/L is shown in Figure 5.1-6 and Figure 5.1-7.

During the current RI, groundwater samples were collected at Line 1 from 13 new and existing monitoring wells and analyzed for explosives (Figure 5.1-7). Additionally, one monitoring well (L1-MW107) was sampled for VOCs. Table 5.1-5 presents the concentrations of chemicals detected in groundwater samples since 2000. Statistical summary tables of the analytical results used in the HHRA are included in Section 5.1.6. Summary tables of all the analytical results (including nondetects) from the 2018–2019 RI activities are provided in Appendix G. Summary tables of all historical analytical results from Line 1 are provided in Appendix H.

VOCs

Low levels of VOCs were detected in previous groundwater samples collected from monitoring wells in 1992 and 1995, and from DPT borings in 1997. Of these, a few VOCs (1,1-DCA, 1,1-DCE, and TCE, and 2-ethyl-1-hexanol) were detected at levels greater than site characterization PALs (if available). The greatest concentrations were reported from DPT boring 11B4, in the northwest corner of the site. To confirm if VOCs were still present in groundwater at Line 1, newly installed monitoring well L1-MW107 was sampled for VOCs in 2018. This well is located approximately 810 feet downgradient of DPT boring 11B4 and approximately 250 feet downgradient of Building 1-01, in which cleaning solvents were used as part of a gauge maintenance shop. Seven VOCs were detected in monitoring well L1-MW107 in 2018. However, none of the VOC concentrations exceeded their site characterization PALs.

SVOCs

Several SVOCs were detected in groundwater at Line 1 at low levels in sampling events prior to the year 2000. Detected SVOCs included phenol, 2-ethylhexanoic acid, 2-ethyl-1-hexanol, benzoic acid, benzyl alcohol, and bis(2-ethylhexyl) phthalate. All concentrations were less than the site characterization PALs (if available), except bis(2-ethylhexyl)phthalate (Appendix H). This chemical is a plasticizer that is used in many common products, including PVC, plastic syringes, and pipette tips. It is not known to have been used at IAAAP. Therefore, its presence is attributed to laboratory or sampling contamination, and it is not considered to be associated with a CERCLA release at these IAAAP sites.

Explosives

Between 2000 and 2019, 14 explosives were detected at Line 1 (Table 5.1-5). During the more recent SRI (2011–2014) and the current RI monitoring event in 2018–2019, five explosives exceeded site characterization PALs in overburden groundwater: RDX, TNT, 2,4-DNT, 2-6-DNT, and 2-nitrotoluene (Table 5.1-5). RDX is present over the greatest extent and has the greatest concentrations. The other explosive compounds' exceedances are located within the extent of the RDX plume and are delineated laterally and vertically.

RDX is present primarily in two larger, greater-concentration plumes and four smaller, lower-concentration plumes, as illustrated on Figures 5.1-5 and 5.1-6:

- The RDX plume with the largest overall extent occurs downgradient of former operational Buildings 1-05-1, 1-05-2, 1-70-1, and 1-100 (Figure 5.1-6); this is referred to as the north RDX plume. The maximum RDX concentration in this plume was observed at temporary well L1-TTTW-062 (827 µg/L in 2014), which was located between intermittent drainage ditches. The plume extent is well understood and has not migrated significantly over time, as supported by the lack of detections in JAW-40, JAW-41, JAW-42, JAW-52, and L1-MW104, which delineate the lateral extent of the plume. The vertical extent of RDX within the north RDX plume is delineated by the lack of detections in monitoring well L1-TTMW-101 (screened from 30 to 35 feet bgs), which was installed adjacent to L1-TTMW-040 (screened from 12.5 to 22.5 feet bgs), where some of the greatest concentrations in this plume have historically been noted. Because the deeper groundwater sample was collected within the greatest-concentration area and was nondetect for RDX, the plume is considered to be vertically delineated.

- The second large plume, referred to as the south RDX plume, is located near several soil removal areas and former Building 1-70 (Figure 5.1-6). The maximum RDX concentration in this plume was observed at temporary well L1-TTTW-009 (2,050 µg/L in 2014), which was located next to soil removal areas near former Building 1-70 and existing Building 1-12. The lateral and vertical extents of this plume were refined during the 2018–2019 monitoring event.
  - Groundwater samples were collected from temporary wells to the north and south of the plume during the SRI, laterally delineating the plume in these directions. New monitoring wells L1-MW103 and L1-MW102 were installed to evaluate the upgradient (east) and downgradient (west) extent of the plume, respectively (Figure 5.1-7). Based on the RDX concentration reported in L1-MW102 (0.053 J µg/L), the downgradient extent of the south RDX plume is defined. The RDX concentration detected in upgradient L1-MW103 (22 µg/L) exceeded the PAL of 2 µg/L. However, this concentration is orders of magnitudes less than the RDX concentration at temporary well L1-TTTW-009 (2,050 µg/L in 2014), which is located immediately downgradient of L1-MW103. This indicates that RDX concentrations trend downward to the east of the soil removal areas, and the plume is not expected to extend much farther in the upgradient direction.
  - To evaluate the vertical extent of the south RDX plume, groundwater samples were collected from L1-TTMW-100 (screened from 32 to 37 feet bgs) adjacent to L1-TTTW-009, where the greatest RDX concentration was detected from 13 to 23 feet bgs. No explosives were detected in the deeper sample. Because the vertical delineation sample was collected within the core of the plume and the till's low permeability retards migration, the south RDX plume is considered vertically delineated.
  - As shown on Figure 5.1-7, this plume overlaps with removal areas, where not all RDX-contaminated soil could be excavated at the time of the removal action. Therefore, soil contamination may be a continuing source to groundwater contamination in this plume.
- One small plume is located adjacent to and downgradient of former subterranean Building 1-40, within the east-northeastern portion of Line 1 (Figure 5.1-6). The maximum RDX concentration in this plume was observed at temporary well L1-TTTW-035 (144 µg/L in 2014), which was located at the southwest corner of former Building 1-40. RDX concentrations in a nearby deeper well (L1-MW-1; screened from 25 to 35 feet bgs) were less by an order of magnitude (at 4.2 µg/L). Therefore, vertical migration appears to be limited. Furthermore, before it was demolished, former Building 1-40 was dewatered to between 15 and 30 feet bgs, which also likely limited vertical migration below the pumped interval. The lateral extent of the plume is defined by groundwater samples collected from temporary wells during the SRI and monitoring well L1-MW105, which was installed during the 2018–2020 RI to evaluate the upgradient extent of the greater-concentration plume area. RDX was not detected in L1-MW105. Therefore, the lateral and vertical extents of the plume have been adequately defined.
- A second small plume is located to the southwest of Building 1-03, within the north-northeastern portion of Line 1. The maximum RDX concentration in this plume was observed at temporary well L1-TTTW-031 (43.9 µg/L in 2014) as shown on Figure 5.1-6. Based on the relatively low concentrations in overburden groundwater, the low permeability of the till, and lack of detections in deeper wells at RDX plumes with greater concentrations, vertical migration of the plume is unlikely. The RDX concentration in L1-MW107 (0.086 J µg/L), installed during the 2018–2020 RI to evaluate the northern extent of the plume, was less than the PAL of 2 µg/L (Figure 5.1-7). Therefore, the lateral extent of the plume has been defined.

- A third small plume is limited in extent to only one DPT boring (IAAP135732), located adjacent to Building 1-10 in the central portion of Line 1 (Figure 5.1-6). The RDX concentration in this boring was 17 µg/L in 2011. Based on the relatively low concentrations in overburden groundwater, low permeability of the till, and lack of detections in deeper wells at RDX plumes with greater concentrations, vertical migration of the plume is unlikely. RDX was not detected in new monitoring well L1-MW104, which was installed downgradient of this plume, thereby further confirming the limited extent of this plume (Figure 5.1-7).
- A fourth small plume within the Line 1 area is also limited to an exceedance in one well (L1-MWUNK1) adjacent to the blast berm and downgradient of Buildings 1-63-1 through 1-63-4 in the east-northeastern portion of Line 1 (Figure 5.1-6). The RDX concentration in this well was 4.6 µg/L in 2012. Based on the relatively low concentrations in overburden groundwater and lack of detections in deeper wells at RDX plumes with greater concentrations, vertical migration of the plume is unlikely. The RDX concentration in L1-MW106 (1.1 µg/L), installed to evaluate the upgradient extent of the plume and potential release area, was less than the PAL of 2 µg/L (Figure 5.1-7). Therefore, the lateral extent of the plume has been defined.

Metals

Between 2000 and 2014, 15 total metals and three dissolved metals were detected at Line 1 (Table 5.1-5). However, only total and dissolved manganese were detected at levels greater than their respective site characterization PALs and BTVs (if available). Total manganese was detected at a level greater than its PAL (430 µg/L) and BTV (579.7 µg/L) at only one location (JAW-41) in November 2004, with a concentration of 4,300 µg/L. This was the only sampling event that this well was sampled for total manganese. Dissolved manganese was detected at levels greater than its PAL (430 µg/L) and its BTV for total manganese (579.7 µg/L) in six temporary and monitoring wells in 2014. The greatest concentrations were measured at monitoring well JAW-48 with a concentration of 824 µg/L. This well is located outside and downgradient of the explosives plume footprint. There is no apparent spatial trend for the distribution of dissolved manganese at Line 1 that would be indicative of a site release (Figure 5.1-8).

Concentrations of some metals may be naturally elevated in the environment, and may not indicate a CERCLA-regulated release. Several metals (such as, total and dissolved iron) were detected at Line 1 at concentrations less than their BTVs and are therefore considered to be consistent with background and naturally occurring. As discussed in the previous paragraph, even though manganese was detected at a level greater than its BTV, the spatial distribution of elevated concentrations is not indicative of a site release.

Radionuclides

Gross alpha and gross beta have been detected in groundwater samples collected at Line 1. The greatest activities were observed in shallow well L1-MW1 just west of Building 1-40; this was the only well that has concentrations that historically exceeded the gross alpha and gross beta MCLs. As a result, this well was included in the periodic groundwater sampling events at IAAAP. Concentrations were less than the gross alpha MCL (15 picocuries per liter [pCi/L]) and gross beta MCL (50 pCi/L) during the last three sampling events (Table 5.1-5).

5.1.5 Fate and Transport

This section discusses the fate and transport of site-related chemicals of interest at Line 1. This includes chemicals that were detected at levels greater than both their site characterization PAL and BTV (if available). In groundwater, potential site-related chemicals of interest include explosives (RDX, TNT, 2,4-DNT, 2-6-DNT, and 2-nitrotoluene) and manganese, based on the most recent SRI (2011–2014) and RI

(2018–2019) monitoring data. Fate and transport characteristics for these chemicals are described in Section 3.2.

Line 1 consists of buildings, roads, railroad tracks, and drainage ditches, which are surrounded by grass-covered areas. The IAAAP site falls within the Brush Creek watershed (Figure 2-1). Surface runoff occurs in unlined drainages (sometimes referred to as tributaries or drainage ditches) and flows toward Brush Creek. Contaminants have entered groundwater at Line 1 due to the historical discharge of process water from buildings and sumps and/or clarifiers and the subsequent leaching of chemicals through unsaturated zone soil. The groundwater table at Line 1 is shallow, and groundwater in the overburden aquifer was encountered at less than 10 feet bgs during the current RI.

Contaminants in groundwater have been transported from the source release areas through advection and dispersion. At Line 1, groundwater flow is directed generally westward toward Brush Creek. However, the potentiometric surface at Line 1 is influenced by several features, including pumping and discharge of water from subterranean buildings, the south branch of the NCED and/or the storm sewer in its vicinity, and the SCED. The overburden aquifer at Line 1 is composed predominantly of silty and sandy clay and silt. Therefore, the groundwater flow is expected to be relatively slow to moderate. However, the velocity may be faster in the areas closer to Brush Creek, where more sand and alluvium is expected.

Natural attenuation mechanisms that are potentially active at Line 1 were evaluated. Natural attenuation includes various physical, chemical, or biological processes that under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. A weight-of-evidence approach was used for this evaluation.

- The primary line of evidence that attenuation is occurring at a site is reduction over time in contaminant concentrations or mass or both. Because most of the groundwater data at Line 1 are based on temporary wells that were sampled during the SRI, limited data are available to assess concentration trends within the explosive plumes. Monitoring well JAW-50 is the only well at Line 1 with RDX exceedances with more than two data points. To assess trends in this well, RDX concentrations were plotted over time (Figure 5.1-9). The trend chart shows RDX concentrations fluctuating, with no overall increasing or decreasing trend, providing inconclusive data for natural attenuation.

- Anaerobic daughter products of RDX were detected at Line 1 at the majority of wells with RDX detections. Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine (MNX) was the most frequently detected chemical with the greatest concentrations being observed at L1-TTTW-009 (51.4 µg/L in 2014). This temporary well had the greatest RDX concentrations at Line 1. Trinitroxylene (TNX) and 1,3-dinitroso-5-nitro-1,3,5-triazacyclohexane (DNX) were also detected at numerous locations at Line 1, with concentrations typically less than 10 µg/L. This provides evidence that anaerobic biodegradation of RDX has occurred in groundwater at Line 1.

- The presence of the amino-DNT isomers in groundwater may be byproducts of anaerobic biodegradation of 2,6-DNT. Historically, nitrate and nitrite, which are aerobic degradation products of 2,6-DNT, have been detected in groundwater at Line 1 and the Line 1 Impoundment (Appendix H). Nitrite is also a degradation product of 2-nitrotoluene, which can degrade via oxidative and reductive pathways (National Library of Medicine, 2015).

- Water quality parameters can be used to evaluate whether the geochemical conditions are conducive to biodegradation. During the current RI, groundwater was observed to be predominantly under aerobic and oxidizing conditions (Table 5.1-6). DO concentrations were typically reported in groundwater at levels greater than 1 mg/L. Oxidation-reduction potential (ORP) values were greater than +50 millivolts (mV) in the majority of wells; however, some negative ORP values (less than -50 mV) were measured at L1-MW102, L1-MW104, L1-MW105, and L1-TTMW-100 (Table 5.1-6).

Therefore, variable reduction-oxidation (redox) conditions may be present. This is consistent with the field parameter data collected during the SRI. Elevated nitrite, sulfide, and methane concentrations were observed in some groundwater samples collected at Line 1, suggesting that variable geochemical exists in the subsurface and more reducing conductions may occur in isolated areas. pH values were relatively neutral (between 6.5 and 7.5), which is favorable for biological activity. Under these geochemical conditions, anerobic biodegradation of explosives, particularly RDX, would be less favorable. Nevertheless, the presence of anerobic RDX daughter products (MNX, DNX, TNX) indicates that anaerobic biodegradation has occurred. On the contrary, the conditions are more favorable for TNT, which can be aerobically biodegraded, reduced by hydrogen under anaerobic conditions, or degraded by biotic cometabolism. The DNTs can also degrade under aerobic conditions, but 2,4-DNT degradation can be resistant (ATSDR, 2013). Nitrobenzene can be used as a carbon source by microorganisms under variable redox conditions.

- The physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in downgradient wells (such as, JAW-41, JAW-42, and L1-MW102). While the explosives (RDX, 4-amino-2,6-DNT, and 2-amino-4,6-DNT) in groundwater have relatively low sorption potential, they should be retarded somewhat as they sorb to the clay geology. However, the explosives have limited volatility (Table 4.2-1) and therefore are unlikely to volatilize into soil gas at the water table interface.

Elevated manganese concentrations in groundwater at Line 1 may be naturally occurring due to localized geochemical conditions based on the distribution of elevated concentrations across the site. The elevated manganese concentrations are not attributed to turbidity in the groundwater samples, as the turbidity levels in most wells were low (< 10 NTU) and samples were filtered (dissolved). However, ORP levels in several of the wells, particularly JAW-48 (-138.1 mV), were more indicative of reducing conditions. JAW-48 had the greatest manganese concentrations. Under reducing conditions, manganese oxides that are present in the natural soil matrix can be naturally transformed to more soluble forms.

As described in Section 4.2, metals are not volatile under normal temperature and pressure conditions; however, their sorption potential is a complex function of pH, organic content, oxide coatings, and other factors; therefore, K_d is not easily estimated by methods other than site-specific testing (USEPA, 1996). Transport and partitioning of inorganic chemicals, such as manganese, is dependent on the oxidation state of the chemical and on interactions with other materials (such as organic matter). pH, which was measured between 6.5 and 7.5 during the sampling events, also factors into inorganic fate and transport; greater pH levels generally favor greater levels of sorption for manganese.

5.1.6 Human Health Risk Assessment

An HHRA was prepared for Line 1 to evaluate potential current and future health risks and hazards from exposure to chemicals in site groundwater. Soil media are not included in the HHRA as soil is not a component of this RI; the soil RI was conducted under OU-1. As discussed in Section 5.1.1.4, contaminants in soil were removed to meet their OU-1 RGs under multiple removal actions, with the exception of RDX at seven areas. Structures at Line 1 are addressed under the remedy for OU-8 (USACE, 2019b). Surface water and sediment media are not included in the HHRA as perennial surface water features are not present at Line 1. The HHRA was conducted in accordance with the final UFP-QAPP (CH2M, 2017a), with the exception of some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final UFP-QAPP. The approach and method used to conduct the HHRA are provided in Section 4.3.1. This section presents the CEM for Line 1 and provides the results of the four-step evaluation process composed of:

- Data evaluation.
- Exposure assessment.

- Toxicity assessment.
- Risk characterization.

The results of the HHRA are used to determine whether further action is warranted for groundwater at Line 1.

5.1.6.1 Conceptual Exposure Model

A description of Line 1, its operational history, previous investigations, and remedial actions are provided in Sections 5.1.1 and 5.1.2. The soil at Line 1 is addressed under the remedy for OU-1 (Leidos, 2018) and was not reevaluated in this HHRA.

The site has functioned as an LAP facility for cartridges, missile warheads, and grenades (JAYCOR, 1996); only a portion of the site is currently active (i.e., southwest portion of Line 1). Line 1 is contiguous with the Line 1 Impoundment, which is discussed in Section 5.2. Buildings at the site not used for ordnance production are either used for storage or are not used. There are no perennial surface water features within the Line 1 site boundary. The site is partially open to recreational activities; therefore, hunting is permitted within the site boundary. Culverts are present at the site; therefore, potential groundwater exposures by future construction/utility workers are complete at Line 1.

Groundwater is not currently being used as a potable water source, and there are no plans to use groundwater for potable purposes in the future; however, based on applicable CERCLA policy and guidance, groundwater at Line 1 is classified as Class IIB, a potential source of drinking water (USEPA, 1989). Therefore, the HHRA for Line 1 evaluates potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater.

The following potential future human receptors were identified in the HHRA for Line 1:

- **Current Site Workers.** Current site workers could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in active buildings at Line 1.
- **Future Site Workers.** Future site workers could contact groundwater based on its potential future use as a drinking water source at Line 1 and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within the Line 1 site.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on its potential future use as a drinking water source at Line 1 and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in future buildings.

As discussed in Section 4.3.1, potential exposures and risks and hazards to current site workers and future site workers and construction/utility workers are estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels and COCs are identified for a residential scenario. The human health CEM presenting potential exposure media, exposure points, receptors, and exposure routes is provided in Appendix A-2 Attachment 1 (Table 1) and depicted graphically on Figure 5.1-10.

5.1.6.2 Data Evaluation

Data Used in the HHRA

The analytical data used in the HHRA consists of groundwater samples collected at Line 1. Historical groundwater samples collected from 2010 through 2014, and recent samples collected in 2018 and 2019 were used in the HHRA for Line 1. Historical groundwater samples were analyzed for explosives, limited metals (total and dissolved iron, lead, and manganese), and an SVOC (1,4-oxathiane). The 2018 groundwater samples were analyzed for explosives. One sample was additionally analyzed by Method SW8260B, which includes VOCs, SVOCs, and the PAH naphthalene; however, neither the PAH nor SVOCs were detected in groundwater samples. The 2019 groundwater samples were analyzed for explosives.

A total of 127 groundwater samples were used to evaluate potential exposures for both a potable use scenario and the VI pathway. The groundwater samples were not collected at multilevel wells; therefore, a separate data grouping (based on shallow groundwater only) was not used to evaluate the VI pathway. A separate groundwater data grouping was used to evaluate a construction/utility worker scenario, assuming construction/utility workers could be exposed to groundwater encountered at depths up to 10 feet bgs. Twenty-seven groundwater samples were used to evaluate potential exposures in a trench for a construction/utility worker.

A summary of the number of chemicals analyzed and detected in groundwater at Line 1 is presented below:

Table 5.1-9. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Explosives	17	14
Metals, Total	3	1
Metals, Dissolved	3	2
PAHs	1	0
SVOCs	1	0
VOCs	66	7

A description of the data groupings and samples included in the HHRA are provided in Tables 5.1-7 and 5.1-8, respectively. The analytical dataset used in the HHRA is included as Appendix A-2, Attachment 2. The groundwater sampling locations included in the HHRA are depicted in Figure 5.1-11.

Screening Results for Site-related Chemicals of Potential Concern and Naturally Occurring Chemicals

The approach and SLs used to select the COPCs (site-related COPCs or naturally occurring chemicals) are described in Section 4.3.1. The results of the COPC screening process for groundwater are provided in Appendix A-2, Attachment 1 (Tables 2.1 through 2.3). Summaries are provided in Tables 5.1-10 and 5.1-11.

Table 5.1-10. Summary of COPCs for Line 1—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water				
Future Site Worker and Future Hypothetical Resident	1,3,5-TNB	12/113	0.2	333
	TNT	10/113	0.1	11.5
	2,4-DNT	4/113	0.079	0.57
	2,6-DNT	1/106	0.086	0.086

Table 5.1-10. Summary of COPCs for Line 1—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
	2-Amino-4,6-DNT	28/106	0.12	34.2
	2-Nitrotoluene	6/106	0.12	13.1
	4-Amino-2,6-DNT	29/106	0.16	28.7
	HMX	67/113	0.053	332
	RDX	69/113	0.086	2050
	TCE	1/1	0.43	0.43
Groundwater to Indoor Air via Vapor Intrusion—no COPCs				
Shallow Groundwater in a Trench (<10 ft bgs)				
Future Construction/Utility Worker	2,6-DNT	1/28	0.086	0.086
	RDX	7/28	0.086	22
	TCE	1/1	0.43	0.43

Table 5.1-11. Summary of COPCs for Site 1—Naturally Occurring Chemicals
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water				
Future Site Worker and Future Hypothetical Resident	Iron, Dissolved	27/75	18.8	2730
	Manganese	1/1	274	274
Groundwater to Indoor Air via Vapor Intrusion—no COPCs				
Shallow Groundwater in a Trench (<10 ft bgs)				
Future Construction/Utility Worker	Manganese, Dissolved	13/15	1.5	824

5.1.6.3 Exposure Assessment

A portion of Line 1 is currently active, and buildings are present at the site; buildings at the site not used for ordnance production are either used for storage or are not used. Several new facilities are planned for construction at Line 1. A portion of the site is open to recreational activities, and hunting is permitted within the site boundary. There are no potentially complete pathways for surface water and sediment because no perennial surface water features are present within Line 1. As previously discussed, groundwater is not currently being used as a potable water source; however, the HHRA for Line 1 evaluated potential exposures to groundwater due to its potential future use as a drinking water source. This consists of evaluating future residential exposures to groundwater. Therefore, exposures to COPCs in groundwater through ingestion, dermal contact, and inhalation of household air (residents) were estimated for future site workers and hypothetical residents. Inhalation exposures to indoor air from vapor intrusion of site groundwater are incomplete because no volatile chemicals were identified as VI COPCs in groundwater at Line 1. Culverts are located at Line 1; therefore, potential ingestion and dermal contact exposures to shallow groundwater in a trench were evaluated for future construction/utility workers. The potential exposure pathways quantified in the HHRA are included in Appendix A-2, Attachment 1 (Table 1) and on Figure 5.1-10. The following receptor scenarios were quantified in the HHRA for Line 1:

- Future site worker.
  - Groundwater (tap water) COPCs—ingestion and dermal contact.
- Future construction/utility worker.
  - Shallow groundwater (trench, 0 to 10 feet bgs) COPCs—incidental ingestion, dermal contact and inhalation of volatiles.
- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion, dermal contact, and inhalation of volatiles in household air.
  - Groundwater (vapor intrusion) COPCs—inhalation of volatiles in indoor air.

Risks and hazards for site workers and construction/utility workers were quantified in the HHRA because the estimated risks or hazards for a hypothetical residential scenario exceeded acceptable risk or hazard levels and COCs were identified for a residential scenario. However, risk and hazards from vapor intrusion for site workers were not quantified in the HHRA because no vapor intrusion-based COCs were identified for a hypothetical residential scenario.

In accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b), groundwater EPCs are typically calculated based on the data collected in the core of the plume. Six RDX plumes (Table 5.1-12) are present at Line 1: two large plumes (a north plume and a south plume) and four small plumes (Figures 5.1-5 and 5.1-6). Each plume is described in Section 5.1.4.2.

Table 5.1-12. Monitoring Wells and Number of Samples from Core of RDX Plumes
Iowa Army Ammunition Plant, Middletown, Iowa

	Large Plumes		**Small Plumes**			
	North	**South**	**1**	**2**	**3**	**4**
Samples	34	25	11	3	1	1
Monitoring Wells	IAAP135774 JAW-50 JAW-602 L1-TTMW-101 L1-TTTW-017 L1-TTTW-018 L1-TTTW-019 L1-TTTW-020 L1-TTTW-024 L1-TTTW-025 L1-TTTW-026 L1-TTTW-027 L1-TTTW-028 L1-TTTW-039	IAAP132578 IAAP132590 IAAP132602 L1-MW103 L1-TTMW-100 L1-TTTW-009 L1-TTTW-010 L1-TTTW-011 L1-TTTW-012 L1-TTTW-015 L1-TTTW-016 L1-TTTW-054 L1-TTTW-056 L1-TTTW-057	L1-MW1 L1-TTTW-021 L1-TTTW-022 L1-TTTW-035 L1-TTTW-043 L1-TTTW-044 L1-TTTW-065	L1-TTTW-031 L1-TTTW-037	IAAP135732	IA92-12

Table 5.1-12. Monitoring Wells and Number of Samples from Core of RDX Plumes
Iowa Army Ammunition Plant, Middletown, Iowa

	Large Plumes		**Small Plumes**			
	North	**South**	**1**	**2**	**3**	**4**
	L1-TTTW-040 L1-TTTW-041 L1-TTTW-046 L1-TTTW-047 L1-TTTW-062 L1-TTTW-063 L1-TTTW-064 L1-TTTW-066 L1-TTTW-072	L1-TTTW-058				

The groundwater EPCs calculated for each RDX plume are provided in Appendix A-2, Attachment 1, Tables 3.1 through 3.6 (potable use) and Tables 3.8 through 3.10 (groundwater in trench). For COPCs not associated with an RDX plume, EPCs are provided in Appendix A-2, Attachment 1, Tables 3.7 (potable use) and 3.11 (groundwater in trench). Future receptors were assumed to have potential exposure to groundwater from all plumes/COPCs; therefore, the greatest EPC of the six plumes (or sitewide MDC for COPCs not associated with a plume) was selected as the final EPC for each COPC, as provided in Appendix A-2, Attachment 1 (Table 3.7 Supplement A [potable], Table 3.11 Supplement A [shallow groundwater in a trench], and Table 3.11 Supplement B [trench air]). As discussed in Section 4.3.1.3, the UCL concentration was calculated for each COPC where at least eight samples were available and at least four detected concentrations were observed and the UCLs were selected as the EPCs. The MDC was selected as the EPC for COPCs when fewer than four detected concentrations were available in the groundwater dataset since a reliable UCL could not be estimated due to the limited number of detected concentrations. The ProUCL output for the COPCs is provided in Appendix A-2, Attachment 3.

The exposure factors used in the calculations for receptor scenarios are included in Appendix A-2, Attachment 1 (Tables 4.1 through 4.4). The primary references for the exposure factor values are the standard default exposure factors presented in the HHEM *Update of Standard Default Exposure Factors* (USEPA, 2014a).

One COPC (TCE) was identified as acting with a MMOA in site media. The ADAFs and exposure assumptions used to calculate adjusted intakes and ECs for TCE are provided in Appendix A-2, Attachment 1 (Table 3.11 Supplement A).

5.1.6.4 Toxicity Assessment

The oral toxicity values (CSFs and RfDs) and inhalation toxicity values (IURs and RfCs) used in the HHRA were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as provided in Section 4.3.1. Noncancer toxicity values for the COPCs identified at Line 1 are provided in Appendix A-2, Attachment 1 (Tables 5.1 and 5.2). Cancer toxicity values for the COPCs are provided in Appendix A-2, Attachment 1 (Tables 6.1 and 6.2).

5.1.6.5 Risk Characterization

The risk characterization for Line 1 was completed using a four-step process, as discussed in Section 4.3.1. The results of each step are discussed below.

Step 1: Total Combined Risks and Hazards from Site-Related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculating receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. The estimated risks and hazards for a hypothetical residential scenario are summarized in Table 5.1-13.

Table 5.1-13. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

				Line 1		
Receptor [a]	**ELCR/HI Tables (RME) in Appendix A-2, Attachment 1**	**Exposure Medium**	**COPC/Chemical**	**EPC [b]**	**ELCR**	**HI**
Hypothetical Resident (Adult)	7.1 and 9.1	Groundwater (Tap water) Line 1 Plumes	Iron, Dissolved	2730	NA	0.1
			Manganese	274	NA	0.4
			1,3,5-TNB	97	NA	0.1
			TNT	9.5	NA	0.6
			2,4-DNT	0.57	NA	0.009
			2,6-DNT	0.086	NA	0.009
			2-amino-4,6-DNT	16	NA	5
			2-Nitrotoluene	3.7	NA	0.1
			4-amino-2,6-DNT	11	NA	3
			HMX	88	NA	0.05
			RDX	837	NA	6
			TCE	0.43	NA	0.1
			Total HI (Groundwater):		**NA**	**16**
Hypothetical Resident (Child)	7.2 and 9.2	Groundwater (Tap water) Line 1 Plumes	Iron, Dissolved	2730	NA	0.2
			Manganese	274	NA	0.6
			1,3,5-TNB	97	NA	0.2
			TNT	9.5	NA	1
			2,4-DNT	0.57	NA	0.01
			2,6-DNT	0.086	NA	0.02
			2-amino-4,6-DNT	16	NA	8
			2-Nitrotoluene	3.7	NA	0.2
			4-amino-2,6-DNT	11	NA	6
			HMX	88	NA	0.09
			RDX	837	NA	11
			TCE	0.43	NA	0.2
			Total HI (Groundwater):		NA	27

Table 5.1-13. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-2, Attachment 1	Exposure Medium	COPC/Chemical	Line 1		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult/Child Aggregate)	7.3 and 9.3	Groundwater (Tap water) Line 1 Plumes	Iron, Dissolved	2730	NA	NA
			Manganese	274	NA	NA
			1,3,5-TNB	97	NA	NA
			2,4,6-TNT	9.5	4E-06	NA
			2,4-DNT	0.57	2E-06	NA
			2,6-DNT	0.086	2E-06	NA
			2-amino-4,6-DNT	16	NA	NA
			2-Nitrotoluene	3.7	1E-05	NA
			4-amino-2,6-DNT	11	NA	NA
			HMX	88	NA	NA
			RDX	837	9E-04	NA
			TCE	0.43	9E-07	NA
			Total ELCR (Groundwater):		**9E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

NA = not applicable

RME = reasonable maximum exposure

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculation of receptor-specific ELCRs and HIs for naturally occurring chemicals. Two COPCs (iron [dissolved] and manganese) were identified as naturally occurring chemicals in site groundwater at Line 1, as discussed in Section 5.1.4.2. The MDCs of dissolved iron and manganese were less than their respective BTVs. The estimated risks and hazards for the naturally occurring chemicals in groundwater for a future hypothetical residential scenario are provided in Table 5.1-14. The naturally occurring chemicals are not used to identify the final COCs for Line 1 and are not discussed further in the HHRA after this step.

Table 5.1-14. Summary of Total Combined Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-2, Attachment 1	Exposure Medium	Chemical	Line 1		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.4 and 9.4	Groundwater (Tap water) Line 1 Plumes	Iron, Dissolved	2730	NA	0.1
			Manganese	274	NA	0.4
			Total HI (Groundwater):		**NA**	**0.5**
Hypothetical Resident (Child)	7.5 and 9.5	Groundwater (Tap water) Line 1 Plumes	Iron, Dissolved	2730	NA	0.2
			Manganese	274	NA	0.6
			Total HI (Groundwater):		**NA**	**0.8**
Hypothetical Resident (Adult/Child Aggregate)	7.6 and 9.6	Groundwater (Tap water) Line 1 Plumes	Iron, Dissolved	2730	NA	NA
			Manganese	274	NA	NA
			Total ELCR (Groundwater):		**NA**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

NA = not applicable

RME = reasonable maximum exposure

Step 3: Risk Characterization of Site-related COPCs

Step 3 consists of calculating receptor-specific ELCRs and HIs associated with site-related COPCs. Ten COPCs (nine explosives and one VOC) were identified as site-related COPCs for groundwater at Line 1. The estimated risks and hazards for site-related COPCs in groundwater for a future hypothetical resident are provided in Table 5.1-15.

Table 5.1-15. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs—Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-2, Attachment 1	Exposure Medium	COPC	Line 1		
				EPC [b]	ELCR	HI
Site Worker (Adult)	7.7 and 9.7	Groundwater (Tap water) Line 1 Plumes	1,3,5-TNB	97	NA	0.03
			TNT	9.5	9E-07	0.2
			2,4-DNT	0.57	5E-07	0.002
			2,6-DNT	0.086	4E-07	0.002
			2-amino-4,6-DNT	16	NA	1
			2-Nitrotoluene	3.7	3E-06	0.04

Table 5.1-15. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs—Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-2, Attachment 1	Exposure Medium	COPC	Line 1		
				EPC [b]	**ELCR**	**HI**
			4-amino-2,6-DNT	11	NA	0.9
			HMX	88	NA	0.02
			RDX	837	2E-04	2
			TCE	0.43	6E-08	0.008
				Total HI (Groundwater):	**2E-04[c]**	**4[d]**
Construction/ Utility Worker (Adult)	7.8 and 9.8	Groundwater (Tap water) Line 1 Plumes	2,6-DNT	0.086	7E-11	0.00002
			RDX	22	2E-10	0.00005
			TCE	0.43	6E-09	1
				Total HI (Groundwater):	**6E-09**	**1**
Hypothetical Resident (Adult)	7.9 and 9.9	Groundwater (Tap water) Line 1 Plumes	1,3,5-TNB	97	NA	0.1
			TNT	9.5	NA	0.6
			2,4-DNT	0.57	NA	0.009
			2,6-DNT	0.086		0.009
			2-amino-4,6-DNT	16	NA	5
			2-Nitrotoluene	3.7	NA	0.1
			4-amino-2,6-DNT	11	NA	3
			HMX	88	NA	0.05
			RDX	837	NA	6
			TCE	0.43		0.1
				Total HI (Groundwater):	**NA**	**16[d]**
Hypothetical Resident (Child)	7.10 and 9.10	Groundwater (Tap water) Line 1 Plumes	1,3,5-TNB	97	NA	0.2
			TNT	9.5	NA	1
			2,4-DNT	0.57	NA	0.01
			2,6-DNT	0.086		0.02
			2-amino-4,6-DNT	16	NA	8
			2-Nitrotoluene	3.7	NA	0.2
			4-amino-2,6-DNT	11	NA	6
			HMX	88	NA	0.09
			RDX	837	NA	11
			TCE	0.43		0.2

Table 5.1-15. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs—Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-2, Attachment 1	Exposure Medium	COPC	Line 1 EPC [b]	Line 1 ELCR	Line 1 HI
			Total HI (Groundwater):		**NA**	**26[d]**
Hypothetical Resident (Adult/Child Aggregate)	7.11 and 9.11	Groundwater (Tap water) Line 1 Plumes	1,3,5-TNB	97	NA	NA
			TNT	9.5	4E-06	NA
			2,4-DNT	0.57	2E-06	NA
			2,6-DNT	0.086	2E-06	
			2-amino-4,6-DNT	16	NA	NA
			2-Nitrotoluene	3.7	1E-05	NA
			4-amino-2,6-DNT	11	NA	NA
			HMX	88	NA	NA
			RDX	837	9E-04	NA
			TCE	0.43	9E-07	
			Total ELCR (Groundwater):		**9E-04[e]**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] The ELCR exceeds 1×10^{-4} (due to 2-nitrotoluene and RDX)—Appendix A-1, Attachment 1 (see Table 9.7).

[d] The HIs for hepatic (due to TNT, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) and nervous (due to RDX) exceed 1—Appendix A-1, Attachment 1 (see Tables 9.7, 9.9, and 9.10).

[e] The ELCR exceeds 1×10^{-4} (due to TNT, 2,4-DNT, 2,6-DNT, 2-Nitrotoluene and RDX)—Appendix A-1, Attachment 1 (see Table 9.11).

NA = not applicable
RME = reasonable maximum exposure

Step 4: Final COC Determination

For groundwater potable use by future hypothetical residents, the target organ–specific HIs exceeded USEPA's threshold of 1 and cumulative ELCR exceeded USEPA's acceptable risk range (1×10^{-6} to 1×10^{-4}) due to the COPCs indicated in Table 5.1-16:

Table 5.1-16. COPCs Exceeding USEPA Target Thresholds—Future Hypothetical Residents
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1×10^{-4}
2-Amino-4,6-DNT 4-Amino-2,6-DNT RDX TNT	2,4-DNT 2,6-DNT 2-Nitrotoluene RDX TNT

These chemicals were identified as COCs in groundwater for future hypothetical residents. Therefore, potential exposures and risks and hazards were also estimated for future site workers and construction/utility workers (summarized in Table 5.1-11). For potable use of groundwater by future site workers, the target organ–specific HIs exceeded USEPA's threshold of 1, and cumulative ELCR exceeded USEPA's acceptable risk range due to the COPCs indicated in Table 5.1-17:

Table 5.1-17. COPCs Exceeding USEPA Target Thresholds—Future Site Workers
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1 × 10^{-4}
2-Amino-4,6-DNT 4-Amino-2,6-DNT RDX TNT	2-Nitrotoluene RDX TNT

For contact with shallow groundwater by future construction/utility workers, the cumulative ELCR and HIs were less than the USEPA's acceptable risk range of 1 × 10^{-6} to 1 × 10^{-4} and acceptable HI of 1, respectively, and no COCs were identified for this receptor. In summary, the following COCs were identified for groundwater, as presented in Appendix A-2, Attachment 1 tables (Table 5.1-18):

Table 5.1-18. Final COCs identified for Groundwater at Line 1
Iowa Army Ammunition Plant, Middletown, Iowa

COC	Site Workers (Table 10.1)	Hypothetical Residents (Tables 10.2–10.4)
2,4-DNT	—	X
2,6-DNT	—	X
2-Amino-4,6-DNT	X	X
2-Nitrotoluene	X	X
4-Amino-2,6-DNT	X	X
RDX	X	X
TNT	X	X

5.1.6.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. The general uncertainties associated with the HHRAs for the sites in this RI report are provided in Section 4.3.1. This section provides additional site-specific uncertainties associated with the HHRA for Line 1 that are not included in Section 4.3.1.

Hazard estimates for 2-amino-4,6-DNT and 4-amino-2,6-DNT could be over- or underestimated because screening RfDs were used in the risk calculations. As stated in the Provisional Peer Reviewed Toxicity Value (PPRTV) documents for 2-amino-4,6-DNT and 4-amino-2,6-DNT (USEPA, 2022a, 2022b),

> It is inappropriate to derive a subchronic or chronic provisional RfD for [2-amino-4,6-dinitrotoluene or 4-amino-2,6-dinitrotoluene]. However, information is available which, although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors… Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of a supplemental screening toxicity value than for a value presented in the body of the assessment.

Chemicals that were 100 percent not detected in groundwater were not included in the COPC identification process; however, they were evaluated in a separate screening to determine if elevated nondetected results were present in groundwater. The detailed analysis of the nondetected chemicals at Line 1 is provided in Appendix A-2, Attachment 4. In summary, two explosives (3-nitrotoluene and nitrobenzene), one PAH (naphthalene), two SVOCs (1,4-dichlorobenzene and hexachlorobutadiene) and 14 VOCs have DLs and/or RLs exceeding SLs at Line 1. Although the RLs and/or DLs for these nondetect chemicals are greater than the SLs, based on the frequency of exceedance and comparison to historically detected chemicals in groundwater at IAAAP, further consideration of nondetect chemicals does not appear warranted in the Line 1 HHRA.

5.1.6.7 Summary of HHRA

An HHRA was prepared for Line 1 to evaluate potential current and future health risks from exposure to chemicals in site groundwater. A portion of Line 1 is currently active, and buildings are present on the site. The site is partially open to recreational activities and hunting is permitted within the site boundary; however, there are no perennial surface water bodies within the site boundaries.

The following potential human receptors were identified in the HHRA for Line 1:

- **Current Site Workers.** Current site workers could be exposed to indoor air (if impacted by VOCs migrating from groundwater) in active buildings at Line 1.
- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 1 and could be exposed to indoor air (if impacted by VOCs migrating from groundwater) in buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within the Line 1 site.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 1 and could be exposed to indoor air (if impacted by VOCs migrating from groundwater) in future buildings.

Potential exposures and risks and hazards to future site workers and construction/utility workers were estimated in the HHRA since estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk and hazard levels and COCs were identified for a residential scenario.

The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are as follows:

- Groundwater (potable use):
  - Naturally occurring: iron, dissolved and manganese.
  - Site-related: 1,3,5-TNB, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 4-amino-2,6-DNT, HMX, RDX, and TCE.
- Groundwater (vapor intrusion): None
- Groundwater (trench scenario):
  - Naturally occurring: manganese, dissolved.
  - Site-related: 2,6-DNT, RDX, and TCE.

The risk characterization for Line 1 was completed using a four-step process, as discussed in Section 4.3.1. Step 1 presents the total combined risks and hazards from site-related COPCs and naturally occurring chemicals, as summarized in Table 5.1-9. Step 2 presents the risks and hazards from naturally occurring chemicals, as summarized in Table 5.1-10. Step 3 presents the risks and hazards from site-related COPCs, as summarized in Table 5.1-11.

Unacceptable groundwater risks and hazards were for hypothetical residents, and TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2,4-DNT, 2,6-DNT, 2-nitrotoluene, and RDX were identified as final COCs. Therefore, groundwater risks and hazards were also estimated for future site workers and construction/utility workers. TNT, 2-amino-4,6-DNT, 2-nitrotoluene, 4-amino-2,6-DNT, and RDX were identified as COCs for future site workers, while no COCs were identified for future construction/utility workers.

In summary, the following COCs were identified for groundwater (Table 5.1-19):

Table 5.1-19. Final COCs for Line 1 Groundwater
Iowa Army Ammunition Plant, Middletown, Iowa

Future Site Worker	Future Construction/ Utility Worker	Future Hypothetical Resident
TNT 2-amino-4,6-DNT 2-nitrotoluene 4-amino-2,6-DNT RDX	None	TNT 2-amino-4,6-DNT 4-amino-2,6-DNT 2,4-DNT 2,6-DNT 2-nitrotoluene RDX

5.1.7 Ecological Risk Assessment

The following sections present the results of Steps 1 and 2 of the SLERA for Line 1.

5.1.7.1 Screening Level Problem Formulation (Step 1)

The screening level problem formulation establishes the goals, scope, and focus of the ERA. As part of the problem formulation, the environmental setting of the site is characterized in terms of the habitats and biota known to be or likely to be present. An ECEM is developed that shows complete exposure pathways. The chemicals that are present in ecologically relevant media are also described based upon available analytical data. Receptors for which ecologically significant exposure pathways exist are evaluated for impact from chemicals present in the relevant media. As discussed in Section 4.3.2, Step 1 of the ERA process is intended to answer two main questions: (1) Do complete exposure pathways exist? and (2) Are sufficient data available to conduct the SLERA? In order to answer these two questions, the Step 1 results focused on three areas: (1) ecological setting, (2) ECEM, and (3) data usage.

Ecological Setting

Line 1 is located within the Brush Creek watershed (Figure 2-1) in the northwestern quadrant of the IAAAP (Figure 1-1). The Line 1 site is sparsely vegetated; dominated by maintained lawns, roads, and structures; and has no permanent waterbodies. The Line 1 site is bounded by Brush Creek and some wooded habitat immediately to the west, and by roads and maintained lawns on all other sides. There are no onsite surface water habitats on the Line 1 site, and terrestrial habitat is limited to the maintained lawns.

Ecological Conceptual Exposure Model

The ECEM is presented on Figure 5.1-12 and shows complete exposure pathways. Important components of the ECEM are the identification of potential source areas, release mechanisms and transport pathways, exposure media, exposure routes, and receptors. Actual or potential exposures of ecological receptors are determined by identifying the most likely, and most important, pathways of contaminant release and transport. A complete exposure pathway has three components: (1) a source of chemicals (stressors) that results in a release to the environment, (2) a pathway of chemical transport through an environmental medium, and (3) an exposure or contact point for an ecological receptor.

If no complete exposure pathways exist, the ERA process terminates at Step 1 with a conclusion of negligible risk. If one or more complete exposure pathways are known to, or are likely to, exist, the ERA process continues to Step 2, but only those pathways that have been determined to be critical are evaluated. Based on the available habitat, there are no potentially complete exposure pathways.

Soil at Line 1 has already been addressed under the remedy for OU-1. There are no perennial surface water features within the Line 1 boundary, so as a result, there are no complete exposure pathways for sediment or surface water at this site. A summary of the Line 1 relationship with the Brush Creek watershed is discussed in the watershed ERA (CH2M, 2022) and included in Appendix I.

Groundwater is present onsite, but ecological receptors are not exposed directly to groundwater. However, groundwater is a transport medium and contaminated groundwater has potential to migrate to and discharge to surface water bodies. Given the lack of perennial surface water bodies at Line 1, the groundwater-to-surface water exposure pathway is incomplete. Because there are no complete exposure pathways for ecological receptors for Line 1, no ecological adverse effects are likely. Therefore, no additional analyses from an ecological perspective are warranted.

5.1.8 Conclusions and Recommendations

An RI was conducted for Line 1 to refine the nature and extent of contamination in groundwater from historical activities and assess for potential unacceptable risk to human health and the environment. Soil at this site has been addressed under the remedial action for OU-1 and is not covered under this RI for OU-6. Analytical data available for groundwater at Line 1 includes VOCs, SVOCs, PAHs, explosives, metals, PCBs, pesticides, herbicides, and radionuclides. Of these, only explosives and metals were identified as site-related chemicals of interest based on historical site operations and a comparison of concentration data to site characterization PALs (listed in Appendix F) and BTVs.

During the most recent groundwater monitoring event for each well (either the 2011–2014 SRI or 2018–2019 RI), only RDX, TNT, 2,4-DNT, 2,6-DNT, and 2-nitrobenzene exceeded their site characterization PALs at Line 1. RDX is the most extensive chemical, and the other explosives are present within the RDX plume extents. RDX is present primarily in two larger, greater-concentration plumes and four smaller, lower-concentration plumes. The largest RDX plume is downgradient of former operational Buildings 1-05-1, 1-05-2, 1-70-1, and 1-100 and is referred to as the north RDX plume. The maximum RDX concentration in this plume was observed at temporary well L1-TTTW-062 (827 µg/L). The second large plume is referred to as the south RDX plume and is located near several soil removal areas and former Building 1-70. The maximum RDX concentration in this plume was observed at temporary well L1-TTTW-009 (2,050 µg/L). This plume overlaps with removal areas, where all RDX-contaminated soil could not be excavated at the time of the removal action. Therefore, soil contamination may be a continuing source to groundwater contamination in this plume. The four small RDX plumes were observed near former subterranean Building 1-40, southwest of Building 1-03, adjacent to Building 1-10, and downgradient of Buildings 1-63-1 through 1-63-4. RDX concentrations in the small plumes were less than 150 µg/L. The lateral and vertical extents of the explosive plumes in groundwater at Line 1 have been defined.

Total and dissolved manganese was the only metal detected at a level greater than its respective site characterization PAL and BTV (if available). The greatest concentrations were measured at monitoring well JAW-48 with a concentration of 824 µg/L. The greatest concentration of total manganese, 4,300 µg/L, was detected at JAW-41 in November 2004. The greatest concentration of dissolved manganese was detected at monitoring well JAW-48 in 2014 with a concentration of 824 µg/L. Elevated manganese concentrations in groundwater are observed across Line 1 and are not coincident with release areas or the explosives plumes. This suggests that manganese is not associated with a site release and may be naturally occurring due to localized geochemical conditions and natural reductive dissolution.

An HHRA and ERA were conducted to quantify potential risks to human health and the environment from exposure to contaminants at Line 1. The following conclusions were made based on the risk assessments:

- The HHRA identified potential unacceptable risks for the following media and receptors for Line 1:
  - Future hypothetical resident: Potential unacceptable risks were identified from exposure to TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2,4-DNT, 2,6-DNT, 2-nitrotoluene, and RDX in groundwater. These chemicals were identified as COCs for future hypothetical residents.
  - Future construction/utility workers: No potential unacceptable noncarcinogenic hazards or carcinogenic risks were identified for exposure to groundwater.
  - Future site workers: Potential unacceptable risks associated with exposure to TNT, 2-amino-4,6-DNT, 2-nitrotoluene, 4-amino-2,6-DNT, and RDX in groundwater were identified.
- The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 1.

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs (TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2,4-DNT, 2,6-DNT, 2-nitrotoluene, and RDX) in groundwater at Line 1. It is recommended that an FS be conducted under OU-6 to evaluate remedial alternatives to address the unacceptable risks in groundwater at Line 1 (CC-IAAP-001G). When developing remedial alternatives, the FS should consider ongoing site operations and the reasonably foreseeable future land use for this area.

5.2 IAAP-016_Line 1 Former Wastewater Impoundment (19105.1021) and IAAP-016G_Line 1 Former Wastewater Impoundment Groundwater (19105.1075)

This subsection summarizes RI activities at the Line 1 Impoundment. An interim remedial action is in place for soil, sediment, and surface water associated with the former wastewater impoundment pond (19105.1021, IAAP-016). The interim action does not address groundwater (19105.1075, IAAP-016G). Although the interim action for the former wastewater impoundment pond (19105.1021, IAAP-016) was referenced in the OU-1 ROD, it was not a component of the OU-1 remedy. This report administratively serves as an additional RI report under CERCLA for all media at the former wastewater impoundment in order to facilitate the future documentation of the interim action, and any groundwater remedy, under a ROD.

5.2.1 Background

5.2.1.1 Site Description

The Line 1 Impoundment is located southwest of Line 1 and covers approximately 26.5 acres (Figure 5.1-1). It includes a former wastewater impoundment pond that is approximately 1,300 feet long and that parallels Brush Creek, which runs through the Line 1 Impoundment site boundary. The former wastewater impoundment pond is a constructed feature that was used to impound explosives-contaminated water from Line 1 prior to its discharge into Brush Creek. In 1997, Brush Creek was rerouted around the impoundment, which was converted into a pond and wetland as part of an interim remedial action (ECC, 2001a; Tetra Tech, 2006b). Surface water in the pond is occasionally discharged to Brush Creek, in accordance with its operation and maintenance (O&M) plan (Aerostar, 2016). The water is treated prior to discharge, if necessary, to ensure RDX concentrations are less than 2 µg/L. A pre-engineered metal building is located near the lower hydraulic control structure and houses a granular activated carbon (GAC) water treatment system.

In fiscal year 2018, a gravel access road was constructed from Road D to the Line 1 Impoundment site to provide a way to enter the area outside of the Line 1 safety arc. As part of the road installation, the safety fence was relocated, and a new gate was installed (PARS-Gannett Fleming, 2021). The Line 1 Impoundment is contiguous with Line 1 (CC-IAAP-001G), which is discussed in Section 5.1.

5.2.1.2 Operational History

The Line 1 Impoundment was created in 1948 when a dam was constructed along the upper reaches of Brush Creek to impound effluent discharged from Line 1 (Dames and Moore, 1989b; Tetra Tech, 2006b). The Line 1 Impoundment was used to allow particulates from explosives-contaminated wastewater to settle prior to the wastewater being discharged downstream. It was sometimes referred to as a "pinkwater lagoon" (SCS, 1982). The sediments that were deposited during the use of the impoundment contained coal fragments. Fly ash was intermittently added to absorb components of explosives and reduce the red color of the water (TN & Associates, 2001). Analyses of water samples taken immediately below the dam in 1952 showed TNT concentrations as great as 114.6 parts per million (TN & Associates, 2001). The dam was breached sometime between 1957 and 1975; however, a review of aerial photos indicated that 1957 is likely the more accurate date (Tetra Tech, 2006b). Brush Creek incised the remaining sediments and returned to its normal gradient and level (Dames & Moore, 1989b). In 1997, active discharge to Brush Creek from Line 1 operations ceased, Brush Creek was rerouted around the Line 1 Impoundment, and an interim remedial action was implemented (Tetra Tech, 2006b).

5.2.1.3 Previous Investigations and Remedial Actions

Numerous investigations have been conducted at IAAAP since the 1980s. Table 5.1-1 summarizes the previous investigations and remedial actions conducted at the Line 1 Impoundment, including conclusions and recommendations. Previous investigations for the Line 1 Impoundment were often conducted in combination with Line 1; therefore, previous investigations for the former impoundment are combined with those for Line 1 in Table 5.1-1 to provide a more comprehensive view of the site history.

This report summarizes the RI for all media at the Line 1 Impoundment (IAAP-016 and IAAP-016G). Previous investigations pertinent to the RI are listed in Table 5.2-1; additional details on these investigations (e.g., a more-detailed description of work completed as well as work not pertinent to this RI) are included in Table 5.1-1. Previous sample locations are shown on Figure 5.1-3.

Table 5.2-1. Excerpts from the Previous Investigations and Remedial Actions Table for Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Underground Pollution Investigation (SCS, 1982)	Groundwater and sediment (waste residue) samples were collected from the Line 1 Impoundment, and surface water samples were collected along Brush Creek as part of the investigation of the Line 1 Impoundment. Samples were analyzed for explosives, SVOCs, metals, pesticides, PCBs, herbicides, and radionuclides. It was concluded that environmental impacts were limited to sediment and media in contact with sediment. No exceedances of groundwater quality criteria were detected.
Contamination Survey (ERG, 1982)	One groundwater sample was collected from the Line 1 Impoundment. Surface water and sediment samples were collected to the north and south of the impoundment. Samples were analyzed for explosives, metals, pesticides, and PCBs. RDX was detected in sediment, surface water, and groundwater. Further delineation of detected explosives was recommended.
Follow-on Study of Environmental Contamination (Battelle, 1984)	Surface water, sediment, and groundwater samples were collected from the Line 1 Impoundment and analyzed for explosives and metals. Explosives were detected in sediment, with greater concentrations present toward the south end of the impoundment. Explosives were also detected in surface water and groundwater. It was concluded that shallow groundwater recharging Brush Creek in the impoundment area was contaminated with RDX from sediments in the impoundment.
Midwest Site Confirmatory Study (Dames & Moore, 1986)	Groundwater samples were collected from monitoring wells within the Line 1 Impoundment and from GZ-6, located to the north of the impoundment and to the west of Line 1. Samples were analyzed for explosives, VOCs, and metals. RDX and HMX were detected in shallow groundwater at Line 1.
Endangerment Assessment/FS, Line 1 Impoundment and Line 800 Pinkwater Lagoon (Dames & Moore, 1989a)	Soil, surface water, sediment, and groundwater samples were collected from the Line 1 Impoundment and analyzed for explosives and metals. RDX and HMX were detected in the surface water sample and in sediment samples. Additional explosives were detected in sediment. RDX and HMX also were detected in monitoring wells GZ-2 and GZ-2A. Metals were not detected in groundwater.
Facility-wide Site Inspection (JAYCOR, 1992)	No groundwater samples were collected during the facility-wide site inspection from the Line 1 Impoundment. It was recommended that Line 1 (and the impoundment) be included in the RI.

Table 5.2-1. Excerpts from the Previous Investigations and Remedial Actions Table for Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Phase I and Follow-on RI (JAYCOR, 1993a, 1996)	Surface water, sediment, and groundwater samples were collected from the Line 1 Impoundment; samples were analyzed for explosives, VOCs, SVOCs, metals, pesticides, PCBs, and radionuclides. Two of the laboratory-analyzed soil samples associated with the Line 1 RI were collected within the Line 1 Impoundment boundary. Four soil samples were also collected within the Line 1 Impoundment site boundary as part of a Brush Creek study and analyzed for explosives, metals, and VOCs. Explosives in surface water and sediment in the impoundment area were considered the result of buildup in depressional areas over time or the erosion of contaminated surface soil/sediment from the Line 1 embankment. In groundwater, metals, and explosives were detected in numerous samples. The RI recommended semiannual groundwater monitoring at Line 1 (and the impoundment) for explosives and metals for compliance with the hazardous waste management regulations for permitted facilities.
Periodic Groundwater and Surface Water Monitoring (multiple reports)	Groundwater samples were collected from the Line 1 Impoundment during multiple sampling events between 1994 and 2008 and analyzed for explosives and metals. Both explosives and metals were detected in samples, but groundwater plumes were generally stable, and evidence of biological degradation was noted.
Baseline Human Health and Ecological Risk Assessment, Former Line 1 Impoundment and Pink Water Lagoon (JAYCOR and ICAIR, 1994)	The 1989 Endangerment Assessment report was rewritten to incorporate USEPA comments on the original document and more current baseline risk assessment approaches. The revised risk assessment concluded that soil/sediment at the Line 1 Impoundment potentially posed risks in excess of 10^{-6}, with RDX being the primary risk driver.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	The work plan noted that Investigation of groundwater and surface water interactions would take place as part of the Brush Creek surface water and sediment investigation work plan for OU-4, and investigation of groundwater data gaps would also occur as part of a facility-wide work plan.
Presupplemental RI Sampling (Tetra Tech, 2014a)	Groundwater water samples were collected from two DPT borings at the Line 1 Impoundment and analyzed for explosives. Explosives were not detected in the sample collected at the southern boundary of the Line 1 Impoundment site. HMX and RDX were detected in the sample collected to the west of the impoundment; however, concentrations were less than SLs.
Phase I, Phase II, and Phase III SRIs (Tetra Tech, 2012a, 2014a, 2014b)	Groundwater samples were collected from temporary wells and permanent monitoring wells at the Line 1 Impoundment. Samples were analyzed for explosives and/or metals. Although several explosives are present in site media, RDX is the primary contaminant. The RI concluded that the RDX groundwater plumes were adequately delineated and that further vertical migration is limited by the low-permeability till geology.

Based on the results of previous investigations, an interim remedial action has been implemented at the Line 1 Impoundment and is ongoing. The action includes the following components: non–time critical removal action (NTCRA) for soil/sediment, rerouting of Brush Creek around the west side of the former impoundment, construction of a water treatment system and hydraulic relief structure, construction of a phytoremediation wetland, treatment system and phytoremediation sampling, and O&M activities. The NTCRA was documented in the Action Memorandum for Pinkwater Lagoon and the Line 1 Impoundment (CDM, 1996). Unlike the soil removals at Line 1, it was not part of the OU-1 final remedy, and the Line 1 Impoundment is not included within the OU-1 LUC boundaries.

Details of the interim remedial action are provided in the final *Remedial Action Report, Multiple Removal Actions, Middletown Iowa* (ECC, 2001a) and the final *Line 1 Impoundment and Line 800 Lagoon*

Operations and Maintenance Plan, Iowa Army Ammunition Plant, Burlington, Iowa (Aerostar, 2016). Interim remedial action components are summarized in the bullets below.

- A permanent diversion dam was constructed upstream of the former impoundment in 1996 to divert Brush Creek from the former impoundment to a parallel path west of the impoundment (ECC, 2001a). Soil was excavated for a diversion channel and a grade control structure (riprap and grouted rock) was constructed across the Brush Creek diversion channel to maintain the surface water elevation in the impoundment pond below the surface water elevation of Brush Creek, thereby preventing any contaminated water in the impoundment from seeping into Brush Creek (Aerostar, 2016).
- An estimated 12,225 cubic yards of contaminated soil and sediment was excavated in 1997 (ECC, 2001a). The removal goals were consistent with the OU-1 RGs; verification samples confirmed that the removal goals were met, except for RDX in a few samples. Additional excavation was not conducted for several reasons, including low contaminant concentrations, minimal human health and ecological risks, and presence of groundwater in the excavations. Approximately 4 to 6 inches of topsoil were placed as part of site restoration activities. Photographs of the site that were taken pre- and post-excavation are presented on Figure 5.2-1.
- Following the NTCRA, an engineered treatment wetland was established. Phytoremediation sampling was conducted between 1998 and 1999.
- Two hydraulic control structures were constructed, starting in 1998. The upper hydraulic control structure was constructed on the north (upstream) end of the impoundment and diverts water into the impoundment from Brush Creek. The lower hydraulic control structure was constructed on the south (downstream) end of the impoundment and controls water surface elevation in the impoundment and discharges water from the system (Aerostar, 2016).
- A GAC treatment system was constructed between 1998 and 1999. A pre-engineered metal building was constructed near the lower hydraulic control structure. The treatment system consists of a 100-micrometer bag filter, a multimedia sand filter, and two GAC vessels, each containing 1,500 pounds of GAC. The system also consists of three 2,100-gallon poly tanks for backwashing the system. Water enters the treatment systems through a submersible pump and discharges to Brush Creek (Aerostar, 2016).
- Procedures are in place to determine whether surface water is released from the Line 1 Impoundment as a direct release or as a treatment system release (Aerostar, 2016). A direct release may occur when RDX concentrations are less than 2 µg/L and turbidity is less than 30 NTU. The treatment system is used when the elevation of the impoundment exceeds the action discharge elevation of 672 feet amsl and RDX concentrations within the impoundment are greater than the site characterization PAL of 2 µg/L. Prerelease sampling is conducted to determine the type of release, and postdischarge and treatment system sampling are conducted to confirm discharge concentrations and treatment effectiveness.
- O&M activities are conducted on a weekly to annual basis to sustain the proper functionality of interim remedial action and maintain the surface water elevation at or below the creek elevation to prevent contaminated water in the impoundment from seeping into Brush Creek. O&M activities address the treatment system used to treat water discharged from the Line 1 Impoundment; hydraulic control of surface water elevations via treated or direct release from Line 1 Impoundment; access road maintenance including snow removal; mowing and other clearing of vegetation; inspection and repair of erosion controls; and repair of erosion or animal-related damage to land features (PARS-Gannett Fleming, 2021). O&M activities and analytical sampling results are documented in annual O&M reports and are not part of this RI.

The treatment system for the Line 1 Impoundment was optimized in 2017. As part of the optimization, the GAC vessels, bag filter housing, pumps, piping, and treatment system control panel were upgraded.

To further optimize the interim remedial action for the Line 1 Impoundment, a sediment removal action was conducted to restore capacity of the impoundment, which had been reduced due to sedimentation. This removal action was also conducted to reduce solids that are collecting in the treatment system bag filter. The work plan estimated that 2,100 cubic yards of sediment would be removed from the impoundment pond (PARS-Gannett Fleming, 2020). This action was initiated in 2020 and completed in July 2021 (PARS-Gannett Fleming, 2022).

5.2.2 2018–2020 Remedial Investigation Activities

Additional field work was conducted at the Line 1 Impoundment to resolve data gaps needed to complete the RI for groundwater (IAAP-016G). As documented in the final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 1)* UFP-QAPP (CH2M, 2017b), monitoring wells were sampled with the following data objective: Groundwater samples were collected from four existing wells to assess current explosives concentrations in groundwater.

Fieldwork completed at the Line 1 Impoundment was conducted in accordance with the UFP-QAPP (CH2M, 2017b). No further investigation was warranted for surface water or sediment, which have been adequately characterized by previous investigations.

Four existing monitoring wells (G-14, GZ-2, GZ-2A, and GZ-3) were sampled via low-flow purging and sampling techniques (with a peristaltic pump) between November 14 and November 16, 2018. Sample locations are shown on Figure 5.1-3. Prior to initiating sampling, a sitewide water-level survey was completed (Table 5.2-2). Groundwater samples were shipped to an offsite laboratory for analysis of explosives by Method SW8330A; monitoring well L1-MW107 also was sampled for VOCs by Method SW8260B. Purge logs are included in Appendix C. Data were managed and validated as discussed in Section 3.3. Laboratory reports are provided in Appendix B.

In 2019, two existing monitoring wells (GZ-2A and GZ-6) were resurveyed since top-of-casing elevation data were not available for these wells. The wells were surveyed by Bruner, Cooper, and Zuck, Inc., licensed Iowa surveyors, in accordance with Section 3.2.8. Survey information is included in Appendix E.

All IDW generated during activities (purge water) was disposed of in accordance with management activities discussed in Section 3.2.9. Waste management documentation is provided in Appendix D.

5.2.3 Environmental Setting

5.2.3.1 Topography and Surface Water

Within the area of the former Line 1 Impoundment, the topographic surface slopes toward Brush Creek, with surface elevations along Brush Creek ranging from approximately 700 feet amsl near the eastern branch of headwaters at the north end of Line 1 to approximately 670 feet amsl south of the former Line 1 Impoundment.

The former Line 1 Impoundment is located between Brush Creek and Line 1, but no intermittent drainages run from Line 1 through the impoundment area. Brush Creek lies to the west of the impoundment pond, within the Line 1 Impoundment site boundary. Surface water is also present within the impoundment pond. As previously discussed, a diversion dam and hydraulic control structures are in place and to maintain the water level in the impoundment pond and creek (ECC, 2001a; Tetra Tech, 2006b). Controlled discharges from the pond to Brush Creek are also used to control water levels.

5.2.3.2 Geology and Hydrogeology

Because Line 1 and the Line 1 Impoundment are contiguous, the geology and hydrogeology of these areas are discussed together. A cross section is provided in Figure 5.1-4. Line 1 is discussed in more detail in Section 5.1.

Geology

In the Line 1 area, fill material up to 5 feet thick comprising clay, silt, and sand was observed. According to interviews with retirees from IAAAP, Line 1 and the Line 1 Impoundment were built on a marshy area. To construct the former Line 1 Impoundment, fill composed of dark brown to black sandy silt/clayey silt containing coal fragments was used. The fill can be distinguished from the natural soil, which is lighter in color (TN & Associates, 2001).

The overburden soil at Line 1 consists primarily of loess (approximately 5 to 10 feet thick), alluvium (up to 7 feet thick), and till (approximately 50 to 90 feet thick at the site) that is underlain by bedrock composed of limestone and shale (Figure 2-7). The predominant lithology of the overburden is clay (sometimes silty and sandy) and silt with discontinuous localized layers of sand or sand and gravel. Bedrock is encountered from 55 to 93 feet bgs. Till and loess thins laterally to the west and are generally absent along Brush Creek. Soil boring logs for the new monitoring wells installed in 2018 are consistent with previously interpreted geology at the site, and showed predominantly lean clay with varying amounts of sand to logging depth, which ranged from 20 to 25 feet bgs (Appendix C).

At Brush Creek, adjacent to the former impoundment, the lithology is alluvium underlain by glacial till. The till is composed of generally homogeneous lean to sandy clay with varying quantities of sand/gravel in discontinuous, localized seams that are typically less than 1 inch thick. The unconsolidated overburden is underlain by bedrock composed of limestone and shale, which was encountered from 55 to 93 feet bgs at JAW-601 (Figure 2-7). The sand fraction coarsens with depth and the till becomes denser.

Hydrogeology

Groundwater levels in the overburden at Line 1 and the former impoundment vary from artesian conditions near Brush Creek to water table conditions (approximately 10 feet bgs) at Line 1. During the 2018 RI field activities, water levels ranged from 0.14 to 9.1 feet bgs (Table 5.2-2). Figure 5.1-5 presents the November 2018 potentiometric surface map at the sites. The direction of overburden groundwater flow in the area is generally toward Brush Creek.

The horizontal gradient in the overburden measured between JAW-44 and SL-81R at the Line 1 Impoundment in August 2018 was 0.055 ft/ft. In bedrock, groundwater flows to the south-southwest (Tetra Tech, 2006b) based on historical, facility-wide gauging events. The horizontal gradient in bedrock groundwater historically has ranged from 0.0022 to 0.017 ft/ft. Vertical gradients between overburden and bedrock groundwater are downward at wells JAW-51/JAW- 603, JAW-50, and JAW-602, as shown on Figure 5.1-5. South of the impoundment, the vertical gradient between the alluvium and till is upward, averaging 0.58 ft/ft between temporary well L1-TTTW- 006 and well GZ-2 and 0.13 ft/ft between wells GZ-2A and GZ-2. This upward gradient is attributed to the proximity of the wells to the creek.

Hydraulic conductivity (*K*) testing has been conducted at only one well at the Line 1 Impoundment. The *K* value in the till has been calculated at 2.43 feet/day through slug testing at well G-14 (Figure 5.1-5). The generally high *K* value may be a result of more-permeable lenses of sand encountered in the borehole between 27 and 38 feet bgs. Well G-14 may not reflect a representative *K* value for the till because the top of the filter pack is at 8 feet bgs, whereas the top of the screen is at 26 feet bgs. For comparison, *K* values calculated in other wells screened in till and till combinations at IAAAP resulted in an average of 0.64 foot/day, as discussed in Section 2.6. At the adjacent Line 2, *K* values were calculated from slug tests and range from 0.00035 to 2.5 feet per day in the overburden (CH2M, 2017b).

5.2.3.3 Groundwater/Surface Water Interaction

Around the former impoundment, Brush Creek has the potential to be a gaining stream (that is, receive groundwater discharge). Groundwater potentiometric levels have been measured at elevations higher and lower than the streambed of Brush Creek, with higher water levels typically measured in the spring (Tetra Tech, 2006b). Based on historical reports, the type of stream (gaining or losing) and degree of interaction between groundwater and surface water varies. The results from previous upstream and downstream sampling to evaluate potential groundwater discharge to Brush Creek in this area have been inconclusive.

5.2.4 Nature and Extent of Contamination

This subsection describes the nature and extent of contamination at the Line 1 Former Wastewater Impoundment. Soil at the Line 1 Impoundment has been addressed under an interim remedial action; however, soil is discussed briefly to inform the CSM for potential groundwater contaminant sources. Surface water and sediment within the pond at the Line 1 Impoundment are also addressed via the interim remedial action. Although the interim action is in place and ongoing, this report administratively fulfills the CERCLA process and will facilitate future documentation of the interim action as a final remedy under a ROD. Brush Creek runs through the western side of the Line 1 Impoundment site; surface water and sediment in the creek are not addressed by the interim remedial action.

The source of contamination at the Line 1 Impoundment includes the historical deposition of explosives-contaminated wastewater, coal fragments, and fly ash within the former impoundment. In 1997, active discharge to Brush Creek from Line 1 operations ceased.

5.2.4.1 Soil and Surface Water/Sediment (within the Impoundment Pond)

Soil and impoundment pond surface water and sediment have been addressed under an interim remedial action for the Line 1 Impoundment. The following discussion summarizes historical initial conditions of site contamination to support the CSM for the site; ongoing interim remedial actions should have decreased concentrations.

At the former impoundment, elevated levels of explosives, including HMX, RDX, and TNT, were identified in sediment and surface water prior to the 1997 remedial actions (Tetra Tech, 2006b). RDX concentrations as great as 400 mg/kg and HMX concentrations as great as 61 mg/kg were reported. The southwest portion of the lagoon, coincident with the general location of an assumed former sludge dumping area, exhibited the greatest explosives concentrations (JAYCOR, 1994b). Concentrations of explosives decreased laterally along Brush Creek but exceeded the leachability RG at a distance of 75 feet west of the creek (CDM, 1996). Explosives contamination appeared to be confined within the depth interval of 0 to 4 feet (CDM, 1996).

Explosives and metals were identified as contaminants of concern for soil and sediment in the *Draft Final Report (Revised) Baseline Human Health and Ecological Risk Assessment, Former Line I Impoundment and Pink Water Lagoon* (JAYCOR, 1994b). Preliminary COCs included RDX, HMX, tetryl, 1,3-dinitobenzene, 2,4-DNT, 2,6-DNT, 1,3,5-TNB, TNT, and barium. Afterwards, the action memorandum (CDM, 1996) identified the following COCs for the Line 1 Impoundment and Pinkwater Lagoon: HMX, RDX, TNT, 1,3,5-TNB, 1,3-dinitrobenzene, nitrobenzene, DNTs, nitrotoluene, and tetryl. As discussed in Section 5.2.2, a NTCRA was conducted in 1997 and removed explosives-contaminated soil and sediment to meet removal action goals, which were based on risk-based industrial soil criteria and leachability criteria (for RDX and TNT). At the time of the removal action, no water was impounded within the area. Verification samples confirmed that the removal goals were met (ECC, 2001a). Photos of the area prior to and following the removal action are included on Figure 5.2-1.

In October 1998, following the 1997 removal, explosives were detected in eight samples collected in sediment at the former impoundment pond during a phytoremediation study, with RDX having the greatest concentrations and a maximum concentration of 7.25 mg/kg, just greater than the OU-1 RG of 1.3 mg/kg.

O&M activities continue to optimize the interim remedial action and control discharge concentrations from the impoundment pond. In 2020, a sediment removal action was conducted to restore capacity of the impoundment; this action also removed explosives-contaminated sediment (if present). As part of O&M activities for the interim remedial action, surface water samples are collected prior to discharge to Brush Creek. If RDX concentrations exceed 2 µg/L, they are treated with GAC prior to discharge to reduce concentrations to an acceptable level. Analytical sample data is provided in annual O&M reports (PARS-Gannett Fleming, 2021).

5.2.4.2 Groundwater

Groundwater samples have been collected from monitoring wells at the Line 1 Impoundment as part of several investigations between 1981 and 2018. Nine monitoring wells are present at the Line 1 Impoundment (Figure 5.1-3). Eight of the wells are screened in the overburden to depths ranging from 5 to 36 feet bgs, and one is screened in the bedrock to depths ranging from 57 to 67 feet bgs. Historical groundwater samples have been analyzed for VOCs, SVOCs, PAHs, explosives, metals, PCBs, pesticides, herbicides, and radionuclides. Detected chemicals are discussed in further detail in the following subsections. No PAHs, herbicides, pesticides, or PCBs were detected in historical groundwater samples. Based on historical site operations and COCs identified in soil, explosives are considered chemicals of interest in groundwater at the Line 1 Impoundment. RDX is the most extensive contaminant in groundwater (Figure 5.2-2).

During the current RI, groundwater samples were collected at Line 1 from four monitoring wells and analyzed for explosives (Figure 5.2-2). Table 5.2-3 presents the concentrations of chemicals detected in groundwater samples since 2000. Statistical summary tables of the analytical results used in the HHRA are included in Section 5.2.6. Summary tables of all the analytical results (including nondetects) from the 2018 RI activities are provided in Appendix G. Summary tables of all historical analytical results from the Line 1 Impoundment provided in Appendix H.

VOCs

Low levels of seven VOCs (benzothiazole, caprolactam, carbon disulfide, chloroform, methane, toluene, and xylenes) were detected in previous groundwater samples collected from monitoring wells between 1992 and 2005 (Appendix H). No VOCs were detected at levels greater than their site characterization PALs.

SVOCs

Two SVOCs (phenol and 4-methylphenol) were detected in previous groundwater samples collected from monitoring wells in 1981 and 1992 (Appendix H). No SVOCs were detected at levels greater than their site characterization PALs.

Explosives

Between 2000 and 2018, 13 explosives were detected at the Line 1 Impoundment. During the more recent SRI (2011–2014) and the current RI monitoring event in 2018, three explosives exceeded site characterization PALs in overburden groundwater: RDX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT (Table 5.2-3).

Explosives contamination in groundwater is present as a relatively small, shallow plume located on the southern end of the former impoundment. The greatest concentrations were reported at monitoring well GZ-2A, which is screened from 5 to 10 feet bgs. In 2018, RDX, 2-amino-4,6-DNT, and 4-amino-2,6-

DNT concentrations were reported at 3,200 J µg/L, 2.9 J µg/L and 5.4 J µg/L, respectively, in this well. This is a decrease from 2004, when RDX was reported at 14,000 µg/L and 2-amino-4,6-DNT and 4-amino-2,6-DNT were reported at 56 µg/L and 61 µg/L, respectively. The plume is horizontally delineated to the west (GZ-3), east (L1-TTTW-008), north (SL-91), and south (L1-TTTW-003 and GZ-14) by existing wells and previous temporary wells. The plume is vertically delineated by monitoring well GZ-2, which is adjacent to high-concentration well GZ-2A and screened from 20 to 30 feet bgs; explosives have not been detected in this well. In addition, an upward hydraulic gradient is noted between these two wells. Neither RDX nor HMX was detected in bedrock well JAW-601.

Metals

Between 2000 and 2014, 14 total metals and 2 dissolved metals were detected at the Line 1 Impoundment (Table 5.2-3). However, manganese was the only total metal detected at a level greater than its respective site characterization PAL and BTV in groundwater. Furthermore, the exceedance was observed in only one well, GZ-2A in 2004 (Table 5.2-3). Of note, the turbidity value was measured at 3.4 NTU in this well at the time of this total manganese exceedance; therefore, the exceedance was not due to elevated turbidity.

During the more recent SRI (2011–2014) monitoring events, only dissolved iron and dissolved manganese were analyzed for. Of these, only dissolved manganese was detected at levels greater than its site characterization PAL and total metal BTV in groundwater. Dissolved manganese exceeded its PAL of 430 µg/L and total metal BTV of 579.7 µg/L in three wells (GZ-2A, JAW-43, and L1-TTW-008). The maximum concentration of 2,810 µg/L was reported at GZ-2A. As previously discussed, this monitoring well also had the greatest explosives concentrations. During these sampling events, turbidity levels in GZ-2A and JAW-43 were relatively low (20.1 NTU or less) while relatively high in L1-TTW-008 (172 NTU). However, given that all the SRI metals samples were filtered the elevated concentrations samples are not attributed to turbidity. It is notable that total manganese was detected in one of these wells (JAW-43) at concentrations less than the PAL and BTV in August 1995 and August 1996 (Appendix H). This well is also located upgradient of the former impoundment (Figure 5.1-3). Therefore, the elevated dissolved manganese detection at this well in 2014 does not appear to be related to the impoundment.

Concentrations of some metals may be naturally elevated in the environment, and may not indicate a CERCLA-regulated release. Several metals (such as total and dissolved iron) were detected at the Line 1 Impoundment at levels less than their BTVs and are therefore considered to be consistent with background and naturally occurring. As discussed in the previous paragraph, even though manganese was detected at a level greater than its BTV, the spatial distribution of elevated concentrations is not indicative of a site release.

Radionuclides

Gross alpha and gross beta have been detected in groundwater samples collected at the Line 1 Impoundment. The greatest gross alpha measurement was observed at monitoring well GZ-2 and the greatest gross beta measurement was observed at GZ-2A (Appendix H). Values in both wells were almost an order of magnitude less than the gross alpha MCL of 15 pCi/L and gross beta MCL of 50 pCi/L.

5.2.4.3 Surface Water and Sediment (Brush Creek)

Surface water and sediment samples have been collected along Brush Creek from 1992 to 2020 within the Line 1 Impoundment site boundary (Figure 5.2-3). The surface water samples were analyzed for explosives, VOCs, and metals, and sediment samples were analyzed for explosives, VOCs, SVOCs, PAHs, PCBs, pesticides, and metals. Detected chemicals are discussed in further detail in the following subsections. PCBs and pesticides were not detected in sediment.

The primary source of chemicals in surface water and sediment samples from Brush Creek is considered to be from other sources than the impoundment, such as Line 1 permitted discharge of explosives through outfalls to Brush Creek. Because multiple IAAAP sites historically contributed to chemicals present in Brush Creek at the IAAAP facility, surface and sediment samples collected from Brush Creek were also evaluated as part of a separate watershed risk assessment deliverable (CH2M, 2022).

VOCs

One VOC was detected in surface water and one VOC was detected in sediment at low levels. In surface water, chloroform was detected in one sample (16SW0101) in 1992 at 0.58 µg/L, less than the site characterization PAL. In sediment, 1,1,3-trimethylcyclohexane was detected in one sample (RBWSD4301) in 1992; there is no site characterization PAL for this VOC. This sample was upstream of the former impoundment.

SVOCs

Ten PAHs were detected in 1992 in one sediment sample, RBWSD4301 (Appendix H), collected in the northern portion of the site and upstream of the former impoundment. Concentrations of the PAHs (1-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene) exceeded ecological PALs; however, concentrations were orders of magnitude less than human health recreational PALs (Appendix F). There were no other SVOCs detected in the sediment sample.

Explosives

Explosives were detected in 11 surface water samples collected both upstream and downstream of the impoundment pond (Table 5.2-4 and Appendix H). The explosive RDX exceeded its site characterization PAL in 1983 in the surface water sample collected from W-52, located in the southern portion of the site, downstream from the impoundment pond. However, the RDX concentration was less than the PAL at this location in 1985. No other explosives were detected at levels greater than their site characterization PALs.

Explosives were detected in four sediment samples collected both upstream and downstream of the impoundment pond (Table 5.2-5 and Appendix H). Five explosives (RDX, HMX, TNT, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) were detected at levels greater than their ecological site characterization PALs in samples collected to the south of the impoundment pond (Figure 5.2-3). However, all explosives concentrations were orders of magnitude less than their human health recreational PALs (Appendix F). Furthermore, concentrations appear to have decreased over time. In 1983, RDX was reported at 20 mg/kg at sample SE-50. In 2006, the greatest RDX concentration in the same area was observed at BC-TTSD-034 at 0.945 mg/kg.

Metals

Metals were detected in six surface water samples collected both upstream and downstream of the impoundment pond. However, there were no metals that were detected at levels that exceeded site characterization PALs and BTVs (if applicable) in the most recent surface water samples collected at each location (Table 5.2-4 and Appendix H).

Metals were detected in four sediment samples collected both upstream and downstream of the impoundment pond. However, metals were not detected at levels that exceeded both the site characterization PALs and BTVs (if applicable) (Table 5.2-5 and Appendix H).

Several metals (such as aluminum and chromium) were detected in surface water and sediment at the Line 1 Impoundment at concentrations less than their BTVs and are therefore considered to be consistent with background and naturally occurring.

5.2.5 Fate and Transport

This section discusses the fate and transport of site-related chemicals of interest at the Line 1 Impoundment. This includes chemicals that were detected at levels greater than both their site characterization PAL and BTV (if available). In groundwater, potential site-related chemicals of interest include explosives (RDX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) and manganese, based on the most recent 2011 to 2014 SRI and 2018 RI monitoring data. In surface water at the Line 1 Impoundment, potential site-related chemicals of interest include explosives (RDX, HMX, TNT, 2-amino-4,6-DNT, and 4-amino-2,6-DNT). In sediment at the Line 1 Impoundment, potential site-related chemicals of interest include explosives (RDX, HMX, TNT, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) and PAHs. Fate and transport characteristics for these chemicals were described in Section 3.2.

The Line 1 Impoundment currently consists of a treatment wetland and pond that is surrounded and covered by grass and other vegetation. The ground topography slopes toward Brush Creek and toward the center of the pond. During period of dry weather conditions, standing water in the pond may be minimal. There are no buildings or permanent structures within the site boundary.

5.2.5.1 Groundwater

Contaminants have entered groundwater at the Line 1 Impoundment due to the historical leaching through soil and sediment at the bottom of the former impoundment, when the site was operational. The groundwater table at the site is shallow, and groundwater in the overburden aquifer was encountered at less than 10 feet bgs during the current RI.

Contaminants in groundwater have been transported from the source release areas through advection and dispersion. At the Line 1 Impoundment, groundwater flow is directed generally westward toward Brush Creek. The overburden aquifer in this area is composed predominantly of silty and sandy clay and silt. However, more sand and alluvium are expected here than at Line 1 given the site's proximity to Brush Creek, and the horizontal gradient at the Line 1 Impoundment (0.055 ft/ft) is steeper than at Line 1 (ranging from 0.016 ft/ft and 0.022 ft/ft). Therefore, groundwater flow at the impoundment area is likely faster than at Line 1.

Natural attenuation mechanisms that are potentially active at Line 1 were evaluated. Natural attenuation includes various physical, chemical, or biological processes that under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. A weight-of-evidence approach was used for this evaluation.

- The primary line of evidence that attenuation is occurring at a site is reduction over time in contaminant concentrations or mass or both. Explosives were detected at levels greater than their site characterization PALs in only one permanent monitoring well (GZ-2A) at the Line 1 Impoundment during the SRI or current 2018 RI monitoring event. To assess trends in this well, RDX concentrations were plotted over time (Figure 5.2-4). The trend chart shows RDX concentrations have fluctuated in this well, with no overall increasing or decreasing trend, providing inconclusive data for natural attenuation. Concentrations have remained at levels greater than 1,000 µg/L since 2007.
- Anaerobic daughter products of RDX were detected at Line 1 Impoundment wells with RDX detections. The greatest concentrations were observed in 2018 at monitoring well GZ-2A, which had MNX, TNX, and DNX concentrations of 110 J µg/L, 59 J µg/L, and 21 J µg/L, respectively. Note, these concentrations are greater than those observed at the adjacent Line 1 site. This provides evidence that anaerobic biodegradation of RDX has occurred in groundwater at the Line 1 Impoundment.
- The presence of the amino-DNT isomers in groundwater may be byproducts of TNT reduction. Both 2-amino-4,6-DNT and 4-amino-2,6-DNT are common intermediates of TNT biotransformation, while 4-amino-2,6-DNT is also an abiotic degradation product of TNT (Battelle, 2015).

- Water quality parameters can be used to evaluate whether the geochemical conditions are conducive to biodegradation. During the current RI, groundwater was observed to be under mildly anaerobic and reducing conditions (Table 5.2-6). DO concentrations were typically reported in groundwater at concentrations less than 1 mg/L, while ORP values were less than -88 mV in all wells (Table 5.2-6). The lowest DO concentration was observed at high-concentration well GZ-2A. Nitrite, sulfide, and methane concentrations were observed in some groundwater samples collected at the Line 1 Impoundment, indicating that reduction processes are occurring in the subsurface. The presence of methane could potentially also be a degradation product of HMX (Battelle, 2015). pH values were neutral (between 7.0 and 8.0), which is favorable for biological activity. Under these geochemical conditions, anerobic biodegradation of explosives (including RDX, HMX, and TNT) should be favorable. TNT may also be degrading under abiotic transformation processes.
- The physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in cross-gradient and downgradient wells (such as GZ-3, L1-TTTW-008, SL-91, L1-TTTW-003, and GZ-14). While the explosives (RDX, HMX, TNT, 4-amino-2,6-DNT, and 2-amino-4,6-DNT) in groundwater have relatively low sorption potential, they should be retarded somewhat as they sorb to the clay geology. However, the explosives have limited volatility (Table 4.2-1) and therefore are unlikely to volatilize into soil gas at the water table interface.

Manganese is not associated with historical operations at the Line 1 Impoundment and elevated manganese concentrations in groundwater at Line 1 may be naturally occurring due to localized geochemical conditions. There were only three locations that had dissolved manganese exceedances of the PAL and background value in groundwater at the Line 1 Impoundment. JAW-43 is located upgradient of the impoundment pond, whereas monitoring wells GZ-2A and L1-TTTW-008 are located south of the impoundment pond, within or near the explosives plume. In the upgradient well (JAW-43), manganese concentrations have fluctuated and were detected at concentrations less than the PAL and BTV in August 1995 and August 1996. Therefore, the elevated dissolved manganese detection at this well in 2014 does not appear to be related to the impoundment. The natural organic matter in the wetland and explosives contamination may be creating more reduced conditions and facilitating reductive dissolution of manganese at the site. The solid forms of manganese (manganese oxides) are usually present in the natural soil matrix. If sufficient amounts of oxygen and nitrate are not present in the subsurface, manganese oxides will be used as electron acceptors by metabolic activity and reductively dissolve into soluble forms. The elevated manganese concentrations are not attributed to turbidity in the groundwater samples, as the turbidity levels in most wells were low (< 10 NTU) and samples were filtered (dissolved). As described in Section 4.2, metals are not volatile under normal temperature and pressure conditions; however, their sorption potential is a complex function of pH, organic content, oxide coatings, and other factors; therefore, K_d is not easily estimated by methods other than site-specific testing (USEPA, 1996). pH, which was measured between 7 and 8 during the sampling events, also factors into inorganic fate and transport; greater pH levels generally favor greater levels of sorption for manganese.

5.2.5.2 Sediment and Surface Water (Brush Creek)

Contaminants have entered sediment and surface water in Brush Creek primarily from sources other than the impoundment, such as Line 1 permitted discharge of explosives through outfalls to Brush Creek. The treatment wetland should continue to reduce concentrations of explosives in sediment and surface water within the impoundment pond via phytoremediation and natural attenuation processes (such as volatilization and dilution) over time. As part of O&M activities for the interim remedial action, surface water samples are collected prior to discharge to Brush Creek. If RDX concentrations exceed 2 µg/L, surface water is treated with GAC prior to discharge to reduce concentrations to an acceptable level. Although the interim action is in place and ongoing, this report administratively fulfills the CERCLA process and will facilitate future documentation of the interim action as a final remedy under a ROD.

5.2.6 Human Health Risk Assessment

An HHRA was prepared for Line 1 Impoundment to evaluate potential current and future health risks and hazards from exposure to chemicals in site groundwater, surface water (Brush Creek), and sediment (Brush Creek). An interim remedial action is in place for soil, sediment, and surface water associated with the former wastewater impoundment pond; therefore, soil, sediment, and surface water in the former wastewater impoundment pond were not evaluated in the HHRA. The HHRA was conducted in accordance with the final UFP-QAPP (CH2M, 2017a), with the exception of some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final UFP-QAPP. The approach and method used to conduct the HHRA are provided in Section 4.3.1. This section presents the CEM for Line 1 Impoundment and provides the results of the four-step evaluation process composed of:

- Data evaluation.
- Exposure assessment.
- Toxicity assessment.
- Risk characterization.

The results of the HHRA are used to determine whether further action is warranted for surface water (Brush Creek), sediment (Brush Creek), and groundwater at Line 1 Impoundment.

5.2.6.1 Conceptual Exposure Model

Line 1 Impoundment, its operational history, previous investigations, and remedial actions are described in Sections 5.2.1 and 5.2.2.

The site includes a former wastewater impoundment pond that is approximately 1,300 feet long and that parallels Brush Creek. The former wastewater impoundment pond is a constructed feature that was used to impound explosives-contaminated water from Line 1 prior to its discharge into Brush Creek. The site is inactive, but there is a pre-engineered metal building located within the Line 1 Impoundment site boundary. The site is open to recreational activities; therefore, hunting is permitted within the site boundary. Culverts are present at the site; therefore, potential groundwater exposures by future construction/utility workers are complete at Line 1 Impoundment.

Groundwater is not currently being used as a potable water source and there are no plans to use groundwater for potable purposes in the future; however, based on applicable CERCLA policy and guidance, groundwater at Line 1 Impoundment is classified as Class IIB, a potential source of drinking water (USEPA, 1989). Therefore, the HHRA for Line 1 Impoundment evaluates potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater.

The following potential current and future human receptors were identified in the HHRA for Line 1 Impoundment:

- **Current and Future Hunters/Recreators (Adult and Adolescent).** Current hunters/recreators could be exposed to surface water and sediment in perennial water bodies while hunting and recreating at the Line 1 Impoundment.
- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 1 Impoundment. Potential exposures to VOCs in indoor air as a result of vapor intrusion from groundwater are incomplete since VOCs were not detected in groundwater.

- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 1 Impoundment.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 1 Impoundment. Potential exposures to VOCs in indoor air as a result of vapor intrusion from groundwater are incomplete since VOCs were not detected in groundwater.

As discussed in Section 4.3.1, potential exposures and risks and hazards to future site workers and construction/utility workers are estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels, and COCs are identified for a residential scenario. The human health CEM presenting potential exposure media, exposure points, receptors (future), and exposure routes is provided in Appendix A-3 Attachment 1 (Table 1) and depicted graphically on Figure 5.2-5.

5.2.6.2 Data Evaluation

Data Used in the HHRA

The analytical data used in the HHRA consisted of surface water (Brush Creek), sediment (Brush Creek), and groundwater samples collected at the Line 1 Impoundment.

- **Surface Water.** Eight historical surface water samples collected in 2000, 2003, 2004, 2007, and 2011 from Brush Creek were used in the HHRA for the Line 1 Impoundment. The 2000, 2003, 2004, 2007, and 2011 surface water samples were analyzed for explosives; the 2000 and 2004 surface water samples were also analyzed for metals.
- **Sediment.** Sediment collected from Brush Creek was treated as sediment in the HHRA because the creek is a perennial water body. Six historical sediment samples collected in 2000, 2003, and 2006 from the creek were used in the HHRA for the Line 1 Impoundment. The 2000, 2003, and 2006 sediment samples from the creek were analyzed for explosives; the 2000 sediment samples were also analyzed for metals.
- **Groundwater.** Historical groundwater samples collected from 2006, 2011, and 2014 and recent samples collected in 2018 were used in the HHRA for Line 1 Impoundment. The 2006, 2011, 2014, and 2018 samples were analyzed for explosives; the 2006, 2011, and 2014 samples were analyzed for one SVOC (1,4-oxathiane); and the 2011 and 2014 samples were analyzed for dissolved iron and manganese.

Twenty groundwater samples were used to evaluate potential exposures for both a potable use scenario and a construction/utility worker scenario. No volatile chemicals were detected in groundwater; therefore, the VI pathway is incomplete.

As stated in the UFP-QAPP (CH2M, 2017a), “Older data (i.e., data collected prior to 2012) may be used in the human health risk assessments if they are still representative of the site (i.e., groundwater flow is slow), chemicals have properties where there would not be a significant reduction in concentrations over time (e.g., metals), or data are conservative for site conditions.” The Line 1 Impoundment is no longer receiving discharge from Line 1 operations, as described in Section 5.2.1. Due to a lack of continuing sources, historical concentrations in surface water and sediment are expected to have remained stable or even decreased due to natural attenuation processes and the interim remedial action. Therefore, the assumptions in the final UFP-QAPP still hold. Samples collected prior to 2012 are considered representative of, or more conservative than, current conditions at the Line 1 Impoundment. The following summarizes the number of chemicals analyzed and detected in site media at the Line 1 Impoundment (Table 5.2-7):

Table 5.2-7. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Groundwater		
Explosives	17	8
Metals, Dissolved	2	2
SVOCs	1	0
Sediment		
Explosives	14	5
Metals	23	18
Surface Water		
Explosives	17	5
Explosives, Dissolved	14	0
Metals, Total	23	14
Metals, Dissolved	23	14

Descriptions of the data groupings and samples included in the HHRA are provided in Tables 5.2-8 and 5.2-9, respectively. The analytical dataset used in the HHRA is included as Appendix A-3, Attachment 2. The surface water (Brush Creek), sediment (Brush Creek), and groundwater sampling locations included in the HHRA are depicted in Figure 5.1-10.

Screening Results for Site-related Chemicals of Potential Concern and Naturally Occurring Chemicals

The approach and SLs used to select the COPCs (site-related COPCs or naturally occurring chemicals) are described in Section 4.3.1. The results of the COPC screening process for a current/future hunter/recreator potentially exposed to surface water and sediment and a future site worker, hypothetical resident, and construction/utility worker potentially exposed to groundwater are provided in Appendix A-3, Attachment 1 (Tables 2.1 through 2.5). The COPCs identified in site surface water, sediment, and groundwater are summarized in Table 5.2-10. No naturally occurring chemicals were identified in site media.

Table 5.2-10. Summary of COPCs for Line 1 Impoundment—Site-Related[a]
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Surface Water—No COPCs				
Sediment—No COPCs				
Groundwater Used for Tap Water				
Future Site Worker and Future Hypothetical Resident	Manganese, Dissolved	10/10	3	2810
	TNT	2/18	0.65	1.5
	2-Amino-4,6-DNT	4/18	1.8	4.3

Table 5.2-10. Summary of COPCs for Line 1 Impoundment—Site-Related[a]
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
	4-Amino-2,6-DNT	4/18	2.5	7.4
	HMX	8/18	0.73	600
	RDX	6/18	1.7	3200
Groundwater to Indoor Air via Vapor Intrusion—No COPCs				
Shallow Groundwater in a Trench (<10 ft bgs)				
Future Construction/Utility Worker	Manganese, Dissolved	10/10	3	2810
	TNT	2/18	0.65	1.5
	2-Amino-4,6-DNT	4/18	1.8	4.3
	4-Amino-2,6-DNT	4/18	2.5	7.4
	HMX	8/18	0.73	600
	RDX	6/18	1.7	3200

[a] No COPCs at the Line 1 Impoundment are naturally occurring.

5.2.6.3 Exposure Assessment

Line 1 Impoundment is currently inactive, but there is a pre-engineered metal building located within the Line 1 Impoundment site boundary. The site is open to recreational activities; therefore, hunting is permitted within the site boundary. Although perennial surface water features are present within the Line 1 Impoundment boundary, there are no potentially complete pathways for surface water and sediment because no COPCs were identified for these media. As previously discussed, groundwater is not currently being used as a potable water source; however, the HHRA for Line 1 Impoundment evaluated potential exposures to groundwater due to its potential future use as a drinking water source. This consisted of evaluating future residential exposures to groundwater. Therefore, ingestion and dermal contact exposures to COPCs in groundwater were evaluated for future site workers and hypothetical residents. Culverts are located at Line 1 Impoundment; therefore, potential ingestion and dermal contact exposures to shallow groundwater in a trench were evaluated for future construction/ utility workers. As noted previously, risks and hazards for site workers and construction/utility workers are estimated only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk or hazard levels and COCs are identified for a residential scenario. Inhalation exposures to site groundwater are incomplete because no VOCs were detected in groundwater at the Line 1 Impoundment. The potential exposure pathways evaluated in the HHRA are included in Appendix A-3, Attachment 1 (Table 1) and in Figure 5.2-5. The following receptor scenarios were quantified in the HHRA for the Line 1 Impoundment:

- Future site worker.
  - Groundwater (tap water) COPCs—ingestion and dermal contact.
- Future construction/utility worker.
  - Shallow groundwater (trench, 0 to 10 feet bgs) COPCs—incidental ingestion and dermal contact.

- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion and dermal contact.

Risks and hazards for site workers and construction/utility workers were quantified in the HHRA because the estimated risks or hazards for a hypothetical residential scenario exceeded acceptable risk or hazard levels and COCs were identified for a residential scenario. Risk and hazards for hunter/recreators were not quantified in the HHRA because no surface water or sediment COPCs were identified.

In accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b), groundwater EPCs are typically calculated based on the data collected in the core of a plume. One small RDX plume is present at the southern end of the Line 1 Impoundment (Figure 5.2-2). Five monitoring wells are located within the core of the plume: GZ-2, GZ-2A, L1-TTTW-005, L1-TTTW-006, and L1-TTTW-007; eight groundwater samples are available in the HHRA dataset for the RDX plume.

For groundwater, where a sufficient number of samples and detected concentrations is available, the UCL on the mean is selected as the EPC for these COPCs. However, for all COPCs for Line 1 Impoundment, fewer than eight samples or four detects were available, so the MDC was selected as the EPC for each COPC. The groundwater EPCs used to estimate the daily intakes for groundwater are provided in Appendix A-3, Attachment 1 (Tables 3.1 and 3.2).

The exposure factors used in the intake calculations for receptor scenarios are included in Appendix A-3, Attachment 1 (Tables 4.1 and 4.2). The primary references for the exposure factor values are the standard default exposure factors presented in the HHEM *Update of Standard Default Exposure Factors* (USEPA, 2014a).

5.2.6.4 Toxicity Assessment

The oral toxicity values (CSFs and RfDs) used in the HHRA were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as provided in Section 4.3.1. Noncancer toxicity values for the COPCs identified at Line 1 Impoundment are provided in Appendix A-3, Attachment 1 (Table 5.1). Cancer toxicity values for the COPCs are provided in Appendix A-3, Attachment 1 (Table 6.1).

5.2.6.5 Risk Characterization

The risk characterization for Line 1 Impoundment was completed using a four-step process, as discussed in Section 4.3.1. The results of each step are discussed below.

Step 1: Total Combined Risks and Hazards from Site-related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculating receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. The estimated risks and hazards for a hypothetical residential scenario are summarized in Table 5.2-11.

Table 5.2-11. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

				Line 1 Impoundment		
Receptor [a]	**ELCR/HI Tables (RME) in Appendix A-3, Attachment 1**	**Exposure Medium**	**COPC/Chemical**	**EPC [b]**	**ELCR**	**HI**
Hypothetical Resident (Adult)	7.1 and 9.1	Groundwater (Tap water)	Manganese, Dissolved	2810	NA	4
			TNT	1.5	NA	0.09
			2-amino-4,6-DNT	4.3	NA	1
			4-amino-2,6-DNT	7.4	NA	2

Table 5.2-11. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-3, Attachment 1	Exposure Medium	COPC/Chemical	Line 1 Impoundment EPC [b]	ELCR	HI
			HMX	600	NA	0.4
			RDX	3200	NA	24
	Total HI (Groundwater—Tap Water):				**NA**	**32**
Hypothetical Resident (Child)	7.2 and 9.2	Groundwater (Tap water)	Manganese, Dissolved	2810	NA	6
			TNT	1.5	NA	0.2
			2-amino-4,6-DNT	4.3	NA	2
			4-amino-2,6-DNT	7.4	NA	4
			HMX	600	NA	0.6
			RDX	3200	NA	40
	Total HI (Groundwater—Tap Water):				**NA**	**53**
Hypothetical Resident (Adult/Child Aggregate)	7.3 and 9.3	Groundwater (Tap water)	Manganese, Dissolved	2810	NA	NA
			TNT	1.5	6E-07	NA
			2-amino-4,6-DNT	4.3	NA	NA
			4-amino-2,6-DNT	7.4	NA	NA
			HMX	600	NA	NA
			RDX	3200	3E-03	NA
	Total ELCR (Groundwater—Tap Water):				**3E-03**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

NA = not applicable

RME = reasonable maximum exposure

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculation of receptor-specific ELCRs and HIs for naturally occurring chemicals. No naturally occurring chemicals were identified in site groundwater at the Line 1 Impoundment.

Step 3: Risk Characterization of Site-Related COPCs

Step 3 consists of calculating receptor-specific ELCRs and HIs associated with site-related COPCs. One metal (manganese, dissolved) and five explosives were identified as site-related COPCs for groundwater at Line 1 Impoundment. The estimated risks and hazards for site-related COPCs in groundwater for future hypothetical residents are provided in Table 5.2-12.

Table 5.2-12. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-3, Attachment 1	Exposure Medium	COPC	Line 1 Impoundment		
				EPC [b]	ELCR	HI
Site Worker	7.4 and 9.4	Groundwater (Tap water)	Manganese, Dissolved	2810	NA	1
			TNT	1.5	1E-07	0.03
			2-amino-4,6-DNT	4.3	NA	0.4
			4-amino-2,6-DNT	7.4	NA	0.6
			HMX	600	NA	0.1
			RDX	3200	8E-04	7
	Total ELCR and HI (Groundwater—Tap Water):				**8E-04[c]**	**9[c]**
Construction/Utility Worker	7.5 and 9.5	Shallow Groundwater (Trench)	Manganese, Dissolved	2810	NA	0.3
			TNT	1.5	1E-11	0.001
			2-amino-4,6-DNT	4.3	NA	0.005
			4-amino-2,6-DNT	7.4	NA	0.008
			HMX	600	NA	0.002
			RDX	3200	2E-07	0.005
	Total ELCR and HI (Shallow Groundwater—Trench):				**2E-07**	**0.3**
Hypothetical Resident (Adult)	7.6 and 9.6	Groundwater (Tap water)	Manganese, Dissolved	2810	NA	4
			TNT	1.5	NA	0.09
			2-amino-4,6-DNT	4.3	NA	1
			4-amino-2,6-DNT	7.4	NA	2
			HMX	600	NA	0.4
			RDX	3200	NA	24
	Total HI (Groundwater—Tap Water):				**NA**	**32[d]**
Hypothetical Resident (Child)	7.7 and 9.7	Groundwater (Tap water)	Manganese, Dissolved	2810	NA	6
			TNT	1.5	NA	0.2
			2-amino-4,6-DNT	4.3	NA	2
			4-amino-2,6-DNT	7.4	NA	4
			HMX	600	NA	0.6
			RDX	3200	NA	40
	Total HI (Groundwater—Tap Water):				**NA**	**53[e]**
Hypothetical Resident	7.8 and 9.8	Groundwater (Tap water)	Manganese, Dissolved	2810	NA	NA
			TNT	1.5	6E-07	NA

Table 5.2-12. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-3, Attachment 1	Exposure Medium	COPC	Line 1 Impoundment		
				EPC [b]	ELCR	HI
(Adult/Child Aggregate)			2-amino-4,6-DNT	4.3	NA	NA
			4-amino-2,6-DNT	7.4	NA	NA
			HMX	600	NA	NA
			RDX	3200	3E-03	NA
Total ELCR (Groundwater—Tap Water):					**3E-03[f]**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] The ELCR exceeds 1×10^{-4} (due to RDX) and the HI for nervous system (due to manganese, dissolved and RDX) exceeds 1—Appendix A-3, Attachment 1 (see table 9.4).

[d] The HIs for hepatic (due to 2-amino-4,6-DNT; 4-amino-2,6-DNT; and HMX) and nervous system (due to manganese, dissolved and RDX) exceed 1—Appendix A-3, Attachment 1 (see table 96).

[e] The HIs for hepatic (due to TNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; and HMX) and nervous system (due to manganese, dissolved and RDX) exceed 1—Appendix A-3, Attachment 1 (see Table 9.7).

[f] The ELCR exceeds 1×10^{-4} (due to RDX)—Appendix A-3, Attachment 1 (see Table 9.8).

NA = not applicable

RME = reasonable maximum exposure

Step 4: Final COC Determination

For groundwater potable use by future hypothetical residents, the target organ–specific HIs exceeded USEPA's threshold of 1 and cumulative ELCR exceeded USEPA's acceptable risk range (1×10^{-6} to 1×10^{-4}) due to the COPCs indicated below (Table 5.2-13):

Table 5.2-13. COPCs Exceeding USEPA Target Thresholds—Future Hypothetical Residents
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1×10^{-4}
Manganese, dissolved 2-Amino-4,6-DNT 4-Amino-2,6-DNT HMX RDX TNT	RDX

These chemicals were identified as COCs in groundwater for future hypothetical residents. Therefore, potential exposures and risks and hazards were also estimated for future site workers and construction/utility workers (summarized in Table 5.2-10).

The maximum detected manganese groundwater concentration was compared to Dietary Reference Intake (DRI)–based screening levels; however, the maximum detected concentration exceeded the screening levels. Therefore, manganese was retained as a COC in groundwater (Table 5.2-14).

Table 5.2-14. Comparison of Manganese Concentration to Screening Levels Developed from the DRI
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical	Maximum Concentration (µg/L)	Adult Screening Level (µg/L)	Child Screening Level (µg/L)	Exceeds SL?	Groundwater COC?
Manganese	2,810	751	451	Yes	Yes

See Appendix A-1, Attachment 5 for development of the DRI-based screening levels.

For potable use of groundwater by future site workers, the target organ–specific HIs exceeded USEPA's threshold of 1 and cumulative ELCR exceeded USEPA's acceptable risk range due to the COPCs indicated below (Table 5.2-15):

Table 5.2-15. COPCs Exceeding USEPA Target Thresholds—Future Site Workers
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1×10^{-4}
Manganese, dissolved RDX	RDX

For contact with shallow groundwater by future construction/utility workers, the cumulative ELCR and HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1, respectively, and no COCs were identified for this receptor. In summary, the following COCs were identified for groundwater, as presented in Appendix A-3, Attachment 1 tables (Table 5.2-16):

Table 5.2-16. Final COCs Identified for Groundwater at Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

COC	Site Workers (Table 10.1)	Hypothetical Residents (Tables 10.2–10.4)
Manganese, dissolved	X	X
TNT	—	X
2-Amino-4,6-DNT	—	X
4-Amino-2,6-DNT	—	X
HMX	—	X
RDX	X	X

5.2.6.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. The general uncertainties associated with the HHRAs for the sites in this RI report are provided in Section 4.3.1. This section provides additional site-specific uncertainties associated with the HHRA for Line 1 Impoundment that are not included in Section 4.3.1.

Hazard estimates for 2-amino-4,6-DNT and 4-amino-2,6-DNT could be over- or underestimated because screening RfDs were used in the risk calculations. As stated in the PPRTV documents for 2-amino-4,6-DNT and 4-amino-2,6-DNT (USEPA, 2022a, 2022b),

> It is inappropriate to derive a subchronic or chronic provisional RfD for [2-amino-4,6-dinitrotoluene or 4-amino-2,6-dinitrotoluene]. However, information is available which, although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors… Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of a supplemental screening toxicity value than for a value presented in the body of the assessment.

Chemicals that were 100 percent not detected in an exposure medium were not included in the COPC identification process; however, they were evaluated in a separate screening to determine whether elevated nondetected results were present in site media. The detailed analysis of the nondetected chemicals at Line 1 Impoundment is provided in Appendix A-3, Attachment 3. In summary, three nondetect explosives in groundwater (2,6-DNT, 2-nitrotoluene, and nitrobenzene) have RLs and/or DLs greater than SLs at Line 1 Impoundment. No nondetect sediment or surface water analytes had DLs or RLs that were greater than SLs. Although the RLs and/or DLs for the three nondetect explosives in groundwater are greater than the SLs, based on evaluation of the DLs and RLs and the comparison to historically detected chemicals in groundwater at IAAAP, further consideration of nondetect chemicals does not appear warranted for the Line 1 Impoundment HHRA.

5.2.6.7 Summary of HHRA

An HHRA was prepared for Line 1 Impoundment to evaluate potential current and future health risks from exposure to chemicals in site groundwater and Brush Creek surface water and sediment. Line 1 Impoundment is currently inactive, but there is a pre-engineered metal building within the Line 1 Impoundment site boundary. The site is open to recreational activities, and hunting is permitted within the site boundary.

The following potential human receptors were identified in the HHRA for Line 1 Impoundment:

- **Current and Future Hunters/Recreators (Adult and Adolescent).** Current/future hunters/recreators could be exposed to surface water and sediment in perennial water bodies (Brush Creek) while hunting and recreating at the site.
- **Future Site Workers.** Future site workers could contact groundwater based on its potential future use as a drinking water source at Line 1 Impoundment. Potential exposures to VOCs in indoor air as a result of vapor intrusion from groundwater are incomplete since VOCs were not detected in groundwater.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 1 Impoundment.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on its potential future use as a drinking water source at Line 1 Impoundment. Potential exposures to VOCs in indoor air as a result of vapor intrusion from groundwater are incomplete since VOCs were not detected in groundwater.

Although perennial surface water features (Brush Creek) are present within the Line 1 Impoundment boundary, there are no potentially complete pathways for surface water and sediment because no COPCs were identified for these media.

Potential exposures and risks and hazards to future site workers and construction/utility workers were estimated in the HHRA since estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk and hazard levels and COCs were identified for a residential scenario.

No naturally occurring COPCs were identified in site media for the Line 1 Impoundment. The site-related COPCs identified in site groundwater are as follows:

- Groundwater (potable use): Manganese, dissolved, TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, and RDX.
- Groundwater (vapor intrusion): None.
- Groundwater (trench scenario): Manganese, dissolved, TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, and RDX.

The risk characterization for Line 1 Impoundment was completed using a four-step process, as discussed in Section 4.3.1. Step 1 presents the total combined risks and hazards from site-related COPCs and naturally occurring chemicals. Step 2 presents the risks and hazards from naturally occurring chemicals; however, this step was not performed for the Line 1 Impoundment because no naturally occurring COPCs were identified in site media. Step 3 presents the risks and hazards from site-related COPCs, as summarized in Table 5.2-12.

Unacceptable groundwater risks and hazards were identified for hypothetical residents and TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, and RDX were identified as final COCs. Therefore, groundwater risks and hazards were also estimated for future site workers and construction/utility workers. RDX was identified as a COC for future site workers, while no COCs were identified for future construction/utility workers.

In summary, the following COCs were identified for groundwater (Table 5.2-17):

Table 5.2-17. Final COCs for Line 1 Impoundment Groundwater
Iowa Army Ammunition Plant, Middletown, Iowa

Future Site Worker	Future Construction/ Utility Worker	Future Hypothetical Resident
Manganese, dissolved RDX	None	Manganese, dissolved TNT 2-amino-4,6-DNT 4-amino-2,6-DNT HMX RDX

5.2.7 Ecological Risk Assessment

The ERA for the Line 1 Impoundment is presented herein, beginning with Step 1 of the ERA process (to determine whether there are complete exposure pathways). Soil at the Line 1 Impoundment is already addressed under the remedy for OU-1. Due to the presence of Brush Creek and the impoundment pond, surface water and sediment show complete exposure pathways. Based on the available habitat, the following exposure pathways are potentially complete:

- Ingestion of biota exposed to surface water or sediment.
- Ingestion of surface water or sediment.
- Dermal contact with surface water or sediment.

However, dermal contact, although a potentially complete pathway, is considered a minor exposure; it is only critical to the risk assessment in specialized cases.

At the Line 1 Impoundment, surface water and sediment are present within the impoundment pond and Brush Creek. However, the ongoing interim remedial action addresses explosives within the impoundment pond and wetland, and no further ERA is warranted for this water body. Surface water and sediment data from the impoundment pond and from Brush Creek were evaluated in the 2020 watershed ERA (CH2M, 2022) for the Brush Creek watershed. From the SLERA, explosives were identified as COPECs for Brush Creek sediment, and lead was identified as a COPEC for Brush Creek surface water; these COPECs were carried forward into the BERA. Following the weight-of-evidence evaluation, no COPECs were identified for Brush Creek. The recommendation of NFA for the Brush Creek watershed overall can be interpreted to apply to the Line 1 Impoundment. A summary of the Line 1 Impoundment relationship with the Brush Creek watershed is discussed in the watershed ERA (CH2M, 2022) and included in Appendix I.

Groundwater is present onsite, but ecological receptors are not exposed directly to groundwater. However, groundwater is a transport medium, and contaminated groundwater has potential to migrate to and discharge to surface water bodies. In this ERA, groundwater was not evaluated as a potential transport medium for Line 1 Impoundment–related chemicals, as there is no significant contamination observed in surface water and sediment samples, per the recommendation of NFA for the Brush Creek watershed reached in the Watershed ERA (CH2M, 2022).

Water collected in the impoundment itself is treated with GAC filtration and discharged to Brush Creek downstream of the impoundment. As part of O&M activities for the interim remedial action of the pond and wetland, surface water samples are collected prior to discharge to Brush Creek. If RDX concentrations exceed 2 µg/L, they are treated with GAC prior to discharge to reduce concentrations to an acceptable level. Samples of treated effluent were collected approximately bimonthly from September 2019 to September 2020 for analysis for an explosive chemical (RDX). RDX was not detected in any samples, but estimated at 0.094–0.096 µg/L, much less than the ESV for RDX in surface water of 79 µg/L. Based on this, it can be assumed that RDX in the treated effluent does not cause adverse effects to ecological receptors.

5.2.8 Conclusions and Recommendations

An RI was conducted for the Line 1 Impoundment to refine the nature and extent of contamination in groundwater from historical activities and assess for potential unacceptable risk to human health and the environment from chemicals in site media. An interim remedial action is in place for soil, sediment, and surface water associated with the former wastewater impoundment pond. The interim action does not address groundwater or surface water and sediment in Brush Creek.

Analytical data available for groundwater at Line 1 includes for VOCs, SVOCs, PAHs, explosives, metals, PCBs, pesticides, herbicides, and radionuclides. Of these, only explosives and metals were identified as site-related chemicals of interest based on historical site operations and a comparison of concentration data to site characterization PALs (listed in Appendix F) and BTVs.

Explosives contamination in groundwater is present as a relatively small, shallow plume on the southern end of the former impoundment. During the most recent groundwater monitoring event for each well (either the 2011–2014 SRI or 2018 RI), only RDX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT exceeded their site characterization PALs at the Line 1 Impoundment. The greatest concentrations were reported at monitoring well GZ-2A, which is screened from 5 to 10 feet bgs. In 2018, RDX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT concentrations were reported at 3,200 J µg/L, 2.9 J µg/L, and 5.4 J µg/L, respectively, in this well. The lateral and vertical extent of the explosives plume in groundwater at this site has been defined.

Total and dissolved manganese was the only metal detected at levels greater than its site characterization PAL and BTV (if available). Total manganese was detected at a level greater than its PAL and BTV in one well (GZ-2A) in 2004. Dissolved manganese exceeded its PAL and total metal BTV in three wells (GZ-2A, JAW-43, and L1-TTW-008); the maximum concentration of 2,810 µg/L was reported at GZ-2A. Nevertheless, manganese is not associated with historical operations at the Line 1 Impoundment and elevated manganese concentrations in groundwater at Line 1 may be naturally occurring due to localized geochemical conditions. In the upgradient well (JAW-43), manganese concentrations have fluctuated and were detected at concentrations less than the PAL and BTV in August 1995 and August 1996. Therefore, the elevated dissolved manganese detection at this well in 2014 does not appear to be related to the impoundment. The natural organic matter in the wetland and explosives contamination may be creating more reduced conditions and facilitating reductive dissolution of manganese at the site. The solid forms of manganese (manganese oxides) are usually present in the natural soil matrix. If sufficient amounts of oxygen and nitrate are not present in the subsurface, manganese oxides will be used as electron acceptors by metabolic activity and reductively dissolve into soluble forms.

An HHRA and ERA were conducted to quantify potential risks to human health and the environment from exposure to contaminants at the Line 1 Impoundment. The following conclusions were made based on the risk assessments:

- The HHRA identified potential unacceptable risks for the following media and receptors:
  - Future hypothetical resident: Potential unacceptable risks and hazards were identified from exposure to manganese (dissolved), TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, and RDX in groundwater. These chemicals were identified as COCs for future hypothetical residents.
  - Future construction/utility workers: No potential unacceptable risks were identified for exposure to groundwater.
  - Future site workers: Potential unacceptable risks associated with exposure to manganese (dissolved) and RDX in groundwater were identified.
- The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at the Line 1 Impoundment Area. Furthermore, no COPECs were identified for Brush Creek during the watershed ERA (CH2M, 2022).

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs at the Line 1 Impoundment. For groundwater at the Line 1 Impoundment (IAAP-016G), one metal (manganese, dissolved) and five explosives (TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, and RDX) were identified as COCs. For soil and sediment at the Line 1 Impoundment (IAAP-016), the Action Memorandum for the Line 1 Impoundment and Pinkwater Lagoon (CDM, 1996) identified explosives (HMX, RDX, TNT, 1,3,5-TNB, 1,3-dinitrobenzene, nitrobenzene, DNT mix, nitrotoluene, and tetryl) as COCs. Under the O&M plan (Aerostar, 2016), impoundment pond water is regularly monitored for RDX concentrations. No human health COCs were identified for surface water or sediment in the portion of Brush Creek that lies within Line 1 Impoundment site boundary.

For administrative purposes, groundwater, surface water, and sediment are retained under the same AEDB number (IAAP-016G). Because soil, surface water, and sediment are all addressed by the interim remedial action, which will require ongoing O&M, it is recommended that both of these IAAAP sites (IAAP-016 and IAAP-016G) be transferred to OU-7, which includes other sites that require ongoing maintenance (such as, disposal or waste pile sites).

It is recommended that an FS be conducted under OU-7 to evaluate remedial alternatives to address the unacceptable risks in groundwater at the Line 1 Impoundment (IAAP-016G). When developing remedial alternatives, the FS should consider ongoing site operations and the reasonably foreseeable future land use for this area.

It is recommended that the interim remedial action be selected as the final remedy for the soil, surface water, and sediment at the Line 1 Impoundment and that O&M of the system continue.

5.3 IAAP-002G_Line 2 Ammo LAP (Artillery/Shape) Groundwater (19105.1003)

This subsection summarizes RI activities at Line 2. This report documents the RI for groundwater at Line 2 (LAP)–Groundwater (IAAP-002G). Soil is addressed under the remedy for OU-1 (Site IAAP-002) (Leidos, 2018). There are no perennial surface water features within the Line 2 site boundary.

5.3.1 Background

5.3.1.1 Site Description

Line 2 is an approximately 140-acre active site in the north-central portion of the IAAAP (Figure 5.3-1), located south of Line 1. Line 2 is currently used to load, assemble, and pack 120-mm ammunition and blank ammunition. The site consists of 31 buildings and covered walkways and includes equipment rooms, explosives magazines, and nine sump buildings (Tetra Tech, 2016) (Figure 5.3-1). A new facility is planned for construction at Line 2.

5.3.1.2 Operational History

The site has been in operation as an LAP line since IAAAP was constructed in 1941, except for a temporary shutdown period from 1947 to 1949 (JAYCOR, 1996). Line 2 has been one of the most consistently operated lines at the IAAAP, even during periods of low production. Ammunition production has included minor and major-caliber rounds and bombs during World War II, renovation and loading of 155-mm and 81-mm rounds in the 1950s, 76-mm and 90-mm rounds in the 1960s, and the current mainstay production of 120-mm antitank rounds. The primary compounds used in ammunition production at Line 2 have been ammonium nitrate, tetryl, RDX, TNT, Composition B (TNT and RDX), black powder, HMX, and pentaerythritol tetranitrate (PETN). In 1954, loading of practice rounds began with inert materials, which included wax, barium, polychloronaphthalene compound, and red lead. Information regarding other current activities is not available due to confidential nature of the present operations.

In 1954, an improved vacuum system was used to collect TNT scrap from drilling operations. Five hundred pounds of TNT was reclaimed and remelted during this process. A preventive maintenance program for TNT-contaminated soil began at Line 2 in January 1957 to prevent and eliminate surface and subsurface soil contamination with TNT. Pilot tests were successful in developing a carbon column filter system for TNT-contaminated water. Reportedly, the effluent water emerged free of TNT. Little else is known about this pilot study, except that carbon columns and newer wastewater lines were later installed at other lines to treat TNT-contaminated effluent water (Tetra Tech, 2006b).

An improvement made in 1958 was the addition of steam cabinets for cleaning explosives-filled shells and brushes used in the renovation process. Cleaning of brushes, metal pans, funnels, and other tools that contacted explosives had previously been done by hand in a washroom supported by a sump. The frequency and use of the steam cabinets and washrooms are unknown (Tetra Tech, 2006b).

Construction projects in the 1980s resulted in significant upgrades to original buildings and the addition of modern production facilities and equipment at Line 2. During these construction projects, soil that had not been tested for contamination was used to restore slopes and drainage characteristics to the area (Shaw, 2004a).

According to the final CWWP (Tetra Tech, 2006b), historical releases may have occurred at Line 2, including from the melt buildings (2-05-1 and 2-05-2), the screening buildings (2-50), and the sump areas. The two melt buildings have been the areas of greatest waste volume. Spills of wastewater generated from processing ordnance or from building washdowns may have occurred within and outside of buildings and from spills during wastewater transport.

Prior to the implementation of the NPDES outfalls, untreated wastewater containing dissolved explosives in the parts per million range was directly discharged to sumps and surface drainage ditches located adjacent to Buildings 2-05-1 and 2-05-2 (URS, 2004a). In the early 1970s, two wastewater treatment buildings were constructed, and NPDES Outfall 21 (Building 2-70-1) and Outfall 22 (Building 2-70-2) were established (Figure 1-2). In October 2000, the treatment system at Outfall 21 was changed so that the processed wastewater was held in a storage tank and analyzed to confirm permit compliance prior to discharge. Outfalls 21 and 22 were included in the latest (2020) NPDES permit (Permit 2900900); however, NPDES discharges have not occurred since 2004 at Outfall 21 or since 2000 at Outfall 22. The outfalls are permitted to discharge effluent with explosives with a 30-day average of 0.75 mg/L and daily maximum discharge of 2.25 mg/L for RDX + HMX and with a 30-day average of 0.33 mg/L and daily maximum discharge of 0.91 mg/L for TNT. Currently, none of the Line 2 buildings (including the melt buildings) discharges explosives-contaminated wastewater.

5.3.1.3 Previous Investigations and Remedial Actions

Numerous investigations have been conducted at IAAAP since the 1980s. Table 5.3-1 summarizes the previous investigations conducted at Line 2, including conclusions and recommendations. Although there are no perennial surface water features within the site boundaries, results from surface water and sediment samples collected from the intermittent features and from Brush Creek are discussed in Table 5.3-1 to support the CSM. Although soil at Line 2 has already been addressed under OU-1, previous investigations for soil are also presented in Table 5.3-1 to support the CSM.

This report summarizes the RI for groundwater at Line 2 (IAAP-002G). Previous investigations pertinent to the RI for groundwater are listed in Table 5.3-2; additional details on these investigations (e.g., including a more-detailed description of work completed, as well as work not pertinent to this RI), are included in Table 5.3-1. Previous groundwater sampling locations are shown on Figure 5.3-2.

Table 5.3-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 2
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	Releases of explosives, solvents, and oils may have occurred during historical site operations at Line 2. Sampling was recommended around the buildings which had the potential for spills in the past.
Facility-wide Site Inspection (JAYCOR, 1992)	No groundwater samples were collected during the facility-wide site inspection.
Phase I and Follow-on RI (JAYCOR, 1993, 1996)	Three piezometers and six monitoring wells were installed and sampled for VOCs, SVOCs, metals, and/or explosives. Chromium, iron, manganese, and a plastic-related compound, methylethyl phenol/methylethyl, were detected in groundwater at piezometer PZ-36, downgradient of sump and melt Building 2-03. Elevated levels of RDX, 2,4-DNT, HMX, and nitrobenzene were detected at monitoring wells JAW-70 through JAW-73. It was recommended that semiannual groundwater monitoring be conducted at Line 2 for metals and explosives.
Periodic Groundwater Monitoring (multiple reports)	Periodic groundwater sampling was conducted at Line 2 between 1994 and 2007 and analyzed for metals and explosives. Explosives and metals were detected, but groundwater plumes were generally stable. Evidence for favorable conditions for biodegradation exists at Line 2; however, other factors may be constraining biodegradation processes.

Table 5.3-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 2
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Supplemental Groundwater RI (MWH, 2001)	Eighteen groundwater samples were collected from temporary and permanent monitoring wells at Line 2 and analyzed for VOCs, SVOCs, metals, and explosives. Methylene chloride, BEHP, and TCE concentrations exceeded SLs. However, methylene chloride and BEHP were attributed to laboratory contamination, and the TCE source was unknown. RDX exceeded its screening criterion at seven locations, and it was concluded that additional delineation was required for the RDX plume at Line 2.
Feasibility Study Data Collection (URS, 2003a)	Groundwater samples were collected from 24 DPT borings and analyzed for explosives. Groundwater samples were also collected from five new monitoring wells and analyzed for explosives, metals, and natural attenuation parameters. Two separate explosives plumes were identified: a Line 2 plume and a Brush Creek plume. RDX and HMX were detected most frequently. Within the Line 2 boundary, the plume was identified near the explosives melt buildings and the NPDES wastewater outfalls. Along Brush Creek, a smaller RDX plume was identified next to a 12-inch water line that crosses Brush Creek, near monitoring well G-15. This plume was not considered to be connected with the contamination at Line 2. There were no explosives exceedances identified in the deepest monitoring wells. Groundwater was considered adequately characterized. Groundwater flow and contaminant fate and transport models were developed. The models predicted that RDX concentrations in groundwater should continue to decline over time due to naturally occurring processes, with the exception of the area around JAW-72. The initial natural attenuation evaluation indicated conditions could be favorable for reductive degradation of RDX. However, the model suggested there could be a continuing source near JAW-72, which could hinder natural attenuation.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	It was concluded that data gaps were present around G-15 and the southern plume and that further investigation around the sewer line upgradient of G-15 was warranted.
SRI Sampling (Tetra Tech, 2012a)	Groundwater samples were collected from two temporary wells around G-15 to delineate RDX contamination. Groundwater was analyzed for explosives. Groundwater results did not indicate that RDX at G-15, along Brush Creek, was connected to Line 2.

BEHP = bis(2-ethylhexyl) phthalate

As part of the previous investigations under OU-1, explosives (TNT, 2,4-DNT, 1,3,5-TNB, and RDX), PAHs, and metals (lead, beryllium, thallium, and arsenic) were identified as soil COCs for Line 1 (Tetra Tech, 2009a). Elevated levels of explosives were identified in soil around melt Buildings 2-05-1 and 2-05-2 (Figure 5.3-1). The PAHs were all detected north of Building 2-01. Buildings within the southern portion of the site (Buildings 2-12, 2-15, and 2-10) contained contamination primarily from metals. To address risks and hazards associated with these COCs, soil removal actions were completed around these buildings and LUCs have been implemented, as summarized in Table 5.3-1. Soil removal areas are shown on Figure 5.3-1. Based on confirmation sampling from soil excavation areas, no soil concentrations greater than OU-1 RGs remain at Line 2 except in two areas near Building 2-05-1: along the floor of the excavation (L2-E10) north of Building 2-05-1 and along the north wall of the excavation (L2-E13) south of Building 2-05-1. USEPA, the Army, and Tetra Tech agreed that the residual soil concentrations for the soil north of Building 2-05-1 were acceptable to leave in place because the concentrations are likely related to groundwater contamination (confirmation soil samples indicated RDX at concentrations similar to those in groundwater) (Tetra Tech, 2009a). Residual soil contamination to the south of Building 2-05-1 could not be removed since contamination extended beneath adjacent Building 2-99-6 (vacuum house); this contamination must be left in place until the vacuum house is removed (Tetra Tech, 2009a). Note that RDX and TNT soil RGs are based on leachability protection levels. Because soil was remediated to its leachability goals for RDX and TNT, the sources to groundwater in the removal areas have been addressed.

Additional soil investigation was conducted at Line 2 in 2022 to determine if contaminated soil exists beneath recently demolished buildings and delineate the contamination in vadose zone soil that exceeds OU-1 RGs (TAC, 2022). The IAAAP is currently undergoing a modernization effort involving the demolition of numerous buildings throughout the Plant. The analytical results will be used to support future remedial design for soil contaminants under OU-1, and would be considered when developing the FS for OU-6, if a new soil source to groundwater was identified.

5.3.2 2018–2020 Remedial Investigation Activities

Additional field work was conducted at Line 2 to resolve data gaps needed to complete the RI for groundwater (IAAP-002G). Groundwater contamination at Line 2 consists primarily of two RDX plumes: a northern plume within the Line 2 site boundary and a southern plume outside the site boundary and along Brush Creek. As documented in the final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 1)* (CH2M, 2017b), additional investigation was warranted to delineate the western extent of the north RDX groundwater plume and the southern extent of the south RDX plume. Fieldwork completed at Line 2 was conducted in accordance with the UFP-QAPP (CH2M, 2017b).

To confirm whether additional monitoring wells were required to delineate the southern extent of the south RDX plume, two existing monitoring wells were sampled prior to any well installation. On April 22, 2018, monitoring well G-15 was sampled using low-flow-purging techniques to understand the current conditions of the southwestern plume. A sampling attempt was also made at monitoring well L2-MW8 on April 23, 2018; however, the well was unable to be sampled via peristaltic pump. Monitoring well L2-MW8 was sampled on May 31, 2018, using a submersible pump. Samples were collected for analysis of explosives by Method SW8330B. Purge logs are included in Appendix C. The UFP-QAPP (CH2M, 2017b) specified that if the analytical results at G-15 or L2-MW8 indicated RDX concentrations were present at levels greater than the screening level, then two contingency wells would be installed. Given that the April 2018 concentrations of RDX at monitoring well G-15 were greater than the site characterization PAL (2 µg/L), it was concluded that the two contingency monitoring wells were warranted to delineate this plume.

To address data gaps, three new permanent overburden monitoring wells were installed, one to delineate the western extent of the north RDX plume (L2-MW9) and two to delineate the south RDX plume (L2-MW10 and L2-MW11) (Figure 5.3-2). Between June 8 and July 12, 2018, three new monitoring wells (L2-MW9 through L2-MW11) were installed at Line 2 with the following data objectives:

- One shallow overburden monitoring well (L2-MW9) was installed to the west of historical piezometer groundwater sample location L2-TTPZ-04 to delineate the downgradient portion of the north RDX plume. L2-MW9 was drilled to 20 feet bgs.
- One shallow overburden monitoring well (L2-MW11) and one deep overburden monitoring well (L2-MW10) were installed south of G-15 to better delineate the south RDX plume (see Section 5.3.4). L2-MW10 was drilled to 50 feet bgs and L2-MW11 was drilled to 17 feet bgs.

New monitoring wells were drilled with a combined DPT/HSA Geoprobe 6620DT drill rig with 8-inch-outer-diameter augers in accordance with Section 3.2.3. At each boring, continuous soil samples were collected to depth and logged for lithologic characterization. Boring logs are provided in Appendix C. Each monitoring well was completed with a 2-inch-nominal-diameter Schedule 40 PVC screen and riser and 0.5-foot Schedule 40 PVC end cap. All monitoring wells were screened with a machine-slotted, 0.010-inch, 10-foot screen. Each monitoring well was constructed with a certified-clean silica sand filter pack from the base of the borehole to 2 feet above the top of the screen, except at L2-MW11 where the filter pack was installed to approximately 1.5 feet above the top of the screen to allow for a sufficient bentonite seal. A 2-foot-thick bentonite layer was placed above the filter pack sand and hydrated. The well was grouted to the surface, and a steel stick-up well protector was installed and surrounded by three bollards. Well construction details are provided in Table 5.3-3. Well completion diagrams are included in Appendix C.

In June and August 2018, newly installed monitoring wells L2-MW9 through L2-MW11 were developed in accordance with Section 3.2.4. L2-MW9 and L2-MW11 were developed on June 22, 2018. Monitoring well L2-MW9 was purged dry at least twice. L2-MW11 did not purge dry, and was considered developed after approximately 1 hour, when groundwater parameters had stabilized, and approximately eight well casing volumes were removed. L2-MW10 was developed on August 5, 2018, and it was also purged dry twice. All Line 2 monitoring wells were considered developed due to the slow recharge. Well development logs are provided in Appendix C.

The three new monitoring wells, nine existing overburden wells, and three existing bedrock monitoring wells were sampled for explosives. Newly installed monitoring well L2-MW11 was sampled on June 25, 2018. The other newly installed monitoring wells (L2-MW9 and L2-MW10) and 12 existing monitoring wells (12-A, 12-C, 12-F, JAW-70, JAW-71, JAW-73, JAW-74, JAW-75, L2-MW1, L2-MW3, L2-MW4, and L2-TT-MW02) were sampled between August 28 and 30, 2018. All samples were collected via low-flow purging and sampling techniques for analysis of explosives by Method SW8330B. Purge logs are included in Appendix C. Data were managed and validated as discussed in Section 3.3. Laboratory reports are provided in Appendix B.

All IDW generated during activities (soil and purge water) was disposed of in accordance with management activities discussed in Section 3.2.9. Waste management documentation is provided in Appendix D.

The three new monitoring wells (L2-MW9, L2-MW10, and L2-MW11) and two existing monitoring wells (L2-TT-MW01 and L2-TT-MW02) were surveyed by Bruner, Cooper, and Zuck, Inc., licensed Iowa surveyors, on September 24, 2018, in accordance with Section 3.2.7. The existing wells were resurveyed due to lack of top-of-casing elevation data. Survey information is included in Appendix E.

5.3.3 Environmental Setting

5.3.3.1 Topography and Surface Water

The topography at Line 2 is relatively flat with a slope to the southwest at the northern part of the site and a slight slope to the west at the majority of the site. Immediately west of the site boundary, the surface elevation drops toward Brush Creek.

There are no perennial features within the Line 2 site boundary. Intermittent surface water drainage occurs through a number of drainage ditches and culverts that ultimately discharge to Brush Creek. In the northern half of the site, surface water is routed through ditches and culverts to Brush Creek between Buildings 2-06-2 and 2-08-2 (Figure 5.3-1). In the southern half of the site, surface water is routed through ditches (approximately 3–5 feet deep) and culverts to a ditch near the southwestern corner of the site that joins Brush Creek just north of Plant Road "I", and to an intermittent tributary at the southern boundary of the site that joins Brush Creek approximately 900 feet south of the site (extent not shown on Figure 5.3-1).

Brush Creek lies approximately 200 feet to the west of Line 2 and dissects the terrain. The creek flows past other production lines to the north of Line 2 (such as Line 1 and Line 3) and to the south of Line 2 (such as Line 800 and Pinkwater Lagoon) and exits the facility at its southern boundary, several miles downstream of Line 2.

5.3.3.2 Geology and Hydrogeology

The overburden at Line 2 is characterized by fill, loess, and glacial till. Loess is present from ground surface to approximately 4 to 6 feet bgs (Tetra Tech, 2006b). The loess is underlain by till, which is characterized as yellowish-brownish and gray, mottled, clayey silt or clayey silt/lean clay and sandy clay with fine- to medium-grained sand and discontinuous localized sand seams. The unconsolidated overburden is underlain by bedrock composed of limestone and shale, which was encountered at depths ranging from 37 to 110 feet bgs. The upper portion of bedrock is weathered and fractured; below this zone, the bedrock becomes more competent and rock quality designations range between 90 and 100 percent (URS, 2004a).

Where Brush Creek has dissected the terrain to the west of Line 2, the glacial till has been eroded away and partially replaced by alluvium (URS, 2004a). As a result, the loess and glacial till soils that are present within the Line 2 site boundary appear to pinch out laterally to the west. The alluvium soil has a greater percentage of sand and gravel than the glacial till and is composed of a heterogeneous, lean to sandy clay (typically 5 to 7 feet bgs) underlain by silty sand to sand (to approximately 10 feet bgs). In some cases, another clayey layer is encountered beneath the sand. Underlying these uppermost units is a sandy clay with fine- to medium-grained sand and discontinuous localized sand seams; the sand fraction coarsens with depth. The lithology identified at well G-15, adjacent to Brush Creek (Figure 5.3-3), is sandy to about 13 feet bgs. Soil boring logs for the new monitoring wells installed in 2018 are consistent with previously interpreted geology at the site (Appendix C). At L2-MW11, which was installed to the east of Brush Creek, sand layers were observed from 5.7 feet bgs to the bottom of the boring (17 feet bgs). At L2-MW10, which was installed to the west of Brush Creek, a fat clay with trace sand and gravel was observed in the soil boring.

Groundwater at Line 2 occurs in the overburden and was encountered at depths ranging from 6 feet bgs to approximately 14 feet bgs during the 2018 RI (Table 5.3-4). However, groundwater has been reported at depths of less than 1 foot in the past. Groundwater flow at Line 2 is toward Brush Creek ranging from southwest to northwest (Figure 5.3-3). Horizontal hydraulic gradients in overburden groundwater are low, ranging from 0.002 to 0.05. Slug test–based hydraulic conductivities (*K* values) range from 0.00035 to 2.5 feet/day in the overburden groundwater. As part of the 1997 SRI (MWH, 2001), a pumping test was proposed to also assess the hydraulic conductivity of the overburden aquifer at Line 2. However, based on observations made during well development, USACE and USEPA concurred that the pumping test was not feasible due to small yields, and no further tests were performed.

To evaluate whether a vertical gradient is present between groundwater in overburden and bedrock, water levels at nested wells pairs were reviewed. Within the Line 2 site boundary, the following wells were evaluated: 12-C (overburden, screened from 40.2 to 50.2 feet bgs) and 12-D (bedrock, screened from 120 to 130 feet bgs). Based on higher groundwater elevations measured at the overburden well than at the bedrock well, there is a downward vertical gradient within the Line 2 site boundary. These wells are located to the west of Building 2-05-1 (Figure 5.3-3). Adjacent to Brush Creek, the following wells were evaluated: G-15 (overburden, screened from 6.5 to 16.5 feet bgs) and L2-MW8 (bedrock, screened from 71.4 to 81.4 feet bgs). A higher groundwater elevation was observed at deep (bedrock) well L2-MW8 than at G-15, indicating an upward vertical gradient is present to the southwest of the site.

5.3.3.3 Groundwater/Surface Water Interaction

At Brush Creek, groundwater is likely not discharging to surface water, or the discharge is infrequent. Based on historical and recent groundwater elevations ranging from 647.26 to 651.08 feet amsl at G-15 relative to the estimated stream bed elevation of 651.24 feet amsl, surface water is losing to groundwater in the area of G-15. Streambed elevation is based on staff gauges BC-SG03 and BC-SG04, roughly equidistant from G-15 (Tetra Tech, 2006b).

5.3.4 Nature and Extent of Contamination

This subsection describes the nature and extent of groundwater contamination at Line 2. Soil has been addressed under OU-1; however, soil is discussed briefly to inform the CSM for potential groundwater contaminants. Groundwater samples have been collected adjacent to or downgradient of potential sources of contamination; these groundwater samples capture contributions from previous soil sources. No perennial surface water or sediment is present at Line 2.

The source of contamination at Line 2 is attributed to wastewater management and LAP activities at the site. During the Preliminary Assessment (JAYCOR, 1994a), wastes found at Line 2 were predominantly explosives (TNT, RDX and Composition B). Other potential wastes included solvents and oils, which could have discharged into the sumps before the wastewater treatment plant was operative or before the solvent recovery system was installed.

5.3.4.1 Groundwater

Groundwater samples have been collected at the Line 2 since 1981. Twenty-eight active monitoring wells are present at Line 2. Twenty-six of the wells are screened in the overburden to depths ranging from 15.5 to 50.4 feet bgs, and two are screened in bedrock at depths ranging from 81.4 to 120 feet bgs (Figure 5.3-2). Historical groundwater samples were analyzed for VOCs, SVOCs, PAHs, explosives, metals, PCBs, and pesticides. No pesticides or PCBs were detected in historical groundwater samples, and no PAHs have been detected in groundwater sampled at Line 2 since 1992. Based on historical site operations and COCs identified in soil, explosives, PAHs, and metals are considered chemicals of interest in groundwater at Line 2.

Samples were collected from 17 monitoring wells during the most recent RI activities, in 2018, and analyzed for explosives (Figure 5.3-4). Table 5.3-5 summarizes the chemicals detected in groundwater between the 2000 and 2018 sampling events at Line 2. Statistical summary tables of the analytical results used in the HHRA are included in Section 5.3.6. Summary tables of all the analytical results (including nondetects) from the 2018 RI activities are provided in Appendix G. Summary tables of all historical analytical results from Line 2 are provided in Appendix H.

VOCs

Eight VOCs have been detected in groundwater at Line 2 (Appendix H). However, only two VOCs (methylene chloride and TCE) exceeded their site characterization PALs. Both methylene chloride and TCE were detected at levels greater than their PALs in only one monitoring well, JAW-72, in 1997. The methylene chloride detection of 5.2 µg/L only just exceeded the PAL of 5 µg/L. The TCE detection of 7.7 µg/L was also just slightly greater than its PAL of 5 µg/L. Methylene chloride was also identified at four temporary locations (10-B, 12-A, 12-E, and 12-G) at concentrations greater than its PAL; however, the data was had a B qualifier, indicating that this chemical was also detected in the equipment blank sample and these concentrations are likely biased high. Therefore, VOC exceedances in groundwater at Line 2 are considered to be limited and isolated to one shallow monitoring well.

SVOCs

Three SVOCs (butylbenzylphthalate, bis(2-ethylhexyl)phthalate, and naphthene) have been detected in groundwater at Line 2 (Appendix H). Of these, only bis(2-ethylhexyl)phthalate exceeded its site characterization PAL. Exceedances were reported in three wells in 1997; however, the maximum concentration of 7.7 µg/L was only slightly greater than the PAL of 6 µg/L. Bis(2-ethylhexyl)phthalate is a plasticizer that is used in many common products, including PVC, plastic syringes, and pipette tips. It is not known to have been used at IAAAP. Therefore, its historical presence is attributed to laboratory or sampling contamination.

Explosives

Between 2000 and 2018, thirteen explosives were detected at Line 2 (Table 5.3-5). During the most recent RI monitoring event, in 2018, four explosives (RDX, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and nitrobenzene) exceeded site characterization PALs at three locations (G-15, JAW-70, and JAW-71). During the previous monitoring events in 2008, five additional explosives (1,3,5-TNB, TNT, 2,4-DNT, 2,6-DNT, and HMX) were detected at levels greater than their site characterization PALs, although concentrations of these five compounds were not detected or were detected at concentrations less than their site characterization PAL during subsequent sampling conducted since 2009.

RDX is present in two distinct plumes at Line 2: a northern plume located within the Line 2 site boundary and a southern plume located outside the Line 2 boundary along Brush Creek, as illustrated on Figure 5.3-4. The other three explosives (2-amino-4,6-DNT, 4-amino-2,6-DNT, and nitrobenzene) were detected at levels greater than their PALs in only one monitoring well (JAW-70), located within the north RDX plume extent, in 2018.

The north RDX plume at Line 2 is the larger of the two plumes and occurs downgradient of Building 2-05-2 (Figure 5.3-4). The maximum RDX concentration in this plume was observed at L2-TT-MW02 (5,270 µg/L in 2007). A treatability study conducted in 2007 and 2008 targeted this hot spot as detailed in Table 5.3-1, and concentrations at this location have been declining since the treatability study (Figure 5.3-7). During the most recent sampling events, in June 2009 and August 2018, concentrations at L2-TT-MW02 were nondetect. During the most recent sampling event in 2018, the greatest concentrations of RDX were observed at JAW-70 (180 J µg/L). Concentrations at this location (JAW-70) have decreased from 970 µg/L in November 2000. RDX continues to not be detected in downgradient monitoring wells (L2-MW9 and 12-A) and cross-gradient monitoring wells (JAW-73 and L2-MW1), indicating that the plume is not migrating. The vertical extent of RDX within the north plume is delineated by monitoring wells 12-F (screened 40.4 to 50.4 feet bgs), L2-MW4 (screened 39 to 49 feet bgs), and L2-MW5 (screened 38.9 to 48.9 feet bgs), which were all nondetect during recent and historical sampling events. 12-F is downgradient of L2-TT-MW02 and adjacent to JAW-72, where the greatest concentrations of RDX have historically been observed. L2-MW4 is colocated with shallow overburden monitoring well JAW-70, where RDX concentrations of 180 J µg/L were observed during the most recent sampling event in 2018. Therefore, the north RDX plume is considered vertically and laterally delineated.

The south RDX plume occurs outside of the Line 2 site boundary to the southwest, along Brush Creek and is smaller than the north plume (Figure 5.3-4). This plume is not related to historical releases at Line 2, and it is most likely associated with a 12-inch water line or previous wastewater discharged to Brush Creek (URS, 2004a); however, it is administratively included with Line 2 due to its proximity to the site. As shown on the figure, the extent of the south RDX plume is defined by the previous DPT groundwater data (see Table 5.3-1) and existing monitoring wells. During the RI sampling event in 2018, RDX was detected in only one monitoring well (G-15) in this plume; the RDX concentration of 72 µg/L exceeded the site characterization PAL (2 µg/L). RDX was not detected at bedrock well L2-MW8 or at downgradient overburden monitoring wells L2-MW10 and L2-MW11 (Figure 5.3-4). Therefore, the southern RDX plume is also considered vertically and laterally delineated.

Metals

Fourteen metals have been detected in groundwater at Line 2 between 2000 and 2008; however, only four metals (arsenic, chromium, iron, and manganese) were detected at levels greater than their site characterization PALs and BTVs (if available).

- Arsenic was detected at levels greater than its site characterization PAL and BTV at three locations (12-C, 12-F, and L2-MW5) between 2000 and 2006; however, dissolved arsenic concentrations exceeded the site characterization PAL only during the latest sampling event, in 2007, and at one location, 12-C (33.1 µg/L). Arsenic was not analyzed during the 2008, 2009, or 2018 sampling events.

This dissolved concentration is similar to the BTV for total arsenic, 33.3 µg/L. This well, 12-C, is not located near a potential release area at Line 2. The elevated arsenic concentrations at 12-C do not appear to be site-related. First, total arsenic concentrations in monitoring wells closer to the source (JAW-72 and JAW-73) were not detected or detected at concentrations less than the PAL and BTV. Similarly, total arsenic concentrations in the shallow well (12-B) that is adjacent to 12-C were also not detected or reported at concentrations less than the PAL and the BTV. Therefore, elevated arsenic concentrations at 12-C are not attributed to a release at Line 2.

- Chromium exceeded its site characterization PAL and BTV in only one historical sample, from 12-C in 2000 (103 µg/L). Subsequent samples at this location from 2000 through 2003 were all less than the PAL and BTV.
- Iron and manganese were detected at levels greater than their site characterization PALs and BTVs between 2008 and 2009 at four locations (JAW-72, JAW-73, L2-TT-MW01, and L2-TT-MW02) (Figure 5.3-6). Manganese was also detected at levels greater than its PAL and BTV at L2-TTPZ-06 in 2008. The maximum concentration of iron (147,000 µg/L) was detected at JAW-73 in 2009, and the maximum concentration of manganese from the latest sampling event was also detected at JAW-73 in 2009 (51,500 µg/L). These elevated concentrations of iron and manganese are not considered to be site-related and are attributed to the enhanced reducing conditions created by the treatability study (Tetra Tech, 2010). As described in Table 5.3-1, high-fructose corn syrup was injected in the subsurface in 2007 to assess the potential for enhanced bioremediation of explosives in groundwater. As part of the performance monitoring plan for this study, L2-TT-MW01 and L2-TT-MW02 were installed. Groundwater samples were collected from these new wells and from existing wells in 2008 and 2009 and analyzed for iron and manganese to help assess whether reducing conditions were being established.

Concentrations of some metals may be naturally elevated in the environment, and may not indicate a CERCLA-regulated release. Several metals (such as cadmium, chromium, lead, mercury, selenium, silver, and zinc) were detected at concentrations less than their BTVs during the latest sampling events and are therefore considered to be naturally occurring in groundwater at Line 2. Although antimony was reported at levels greater than its BTV of 2.22 µg/L, it is also considered to be consistent with background and naturally occurring. Antimony exceedances were observed in only two monitoring wells, G-15 and JAW-70, at concentrations of 2.6 B µg/L and 3.6 B µg/L, respectively (Appendix H). Both concentrations just slightly exceed the BTV and are B-qualified, which indicates that antimony was also detected in the associated method and/or calibration blank, and these monitoring well concentrations are likely biased high. Previous antimony results at these wells were nondetect or detected at concentrations less than the BTV. There is no reported use of antimony at Line 2.

5.3.4.2 Sediment and Surface Water

There are no perennial surface water features within the Line 2 site boundary. Brush Creek lies approximately 200 feet to the west of Line 2, and surface water and sediment within the creek have been evaluated in the watershed ERA (CH2M, 2022). However, the south RDX plume in groundwater lies across Brush Creek and may be associated with historical discharges to the creek. Therefore, surface water and sediment data in the vicinity of the south RDX plume are discussed in this subsection to support the CSM.

Figure 5.3-5 shows RDX concentrations in surface water and sediment upstream and downstream of the south RDX groundwater plume. In surface water, samples were most recently collected in 2019, in support of the OU-3 CSM. In the 2019 surface water samples located upstream of the south RDX plume (OU3-SW02 and OU3-SW06), RDX concentrations were detected at 27 µg/L and 22 µg/L, respectively. In the 2019 surface water samples located at the downgradient edge of the south RDX plume (OU3-SW01 and OU3-SW05), RDX was detected at 33 µg/L and 25 µg/L, respectively. Sediment near the south RDX groundwater plume was last sampled in 2006. In the upstream sediment samples (BC-TTSD-026 and BC-

TTSD-027), RDX concentrations were detected at 0.293 mg/kg and 2.37 mg/kg, respectively. Concentrations in the sediment samples located downstream of the south RDX plume (BC-TTSD-022, BC-TTSD-023, and BC-TTSD-024) were slightly greater, at 2.87 mg/kg, 0.149 J mg/kg, and 4.61 mg/kg, respectively.

Given that RDX concentrations in Brush Creek upstream of the south RDX plume were similar to concentrations at the downgradient edge or downstream of the south RDX groundwater plume, this groundwater plume along Brush Creek does not appear to be a source of RDX contamination in surface water. This is consistent with the hydrologic CSM for the site, which indicates that surface water appears to be losing to groundwater in this area. Although sediment concentrations were slightly greater in the downstream samples, this is most likely related to normal variation observed in solid media (soil, sediment) samples or transportation of sediment particulates downstream to an area subject to deposition. Since Line 2 no longer discharges explosives-contaminated wastewater, it is also not considered a source of RDX to surface water and sediment in Brush Creek.

5.3.5 Fate and Transport

This section discusses the fate and transport of site-related chemicals of interest at Line 2. This includes chemicals that were detected at levels greater than both their site characterization PAL and BTV (if available) during the last sampling event that those chemicals were analyzed. In groundwater, potential site-related chemicals of interest include explosives (RDX, 4-amino-2,6-DNT, 2-amino-4,6-DNT, and nitrobenzene) and VOCs (methylene chloride and TCE). Fate and transport characteristics for these chemicals are described in Section 3.2.

Line 2 is an active LAP facility with buildings, covered walkways, roads, and railroad tracks that are surrounded by grass-covered areas. This site falls within the Brush Creek watershed (Figure 2-1). Surface water drainage occurs through a number of drainage ditches and culverts, which ultimately discharge to Brush Creek (Figure 5.3-1). The groundwater table at Line 2 is shallow, observed at overburden monitoring wells between 6 and 14 feet bgs within the Line 2 site boundary during the current RI (Table 5.3-5). The source of contamination at Line 2 is attributed to releases related to wastewater management (including NPDES discharges) and LAP activities. The source of contamination along Brush Creek, to the west of the Line 2 site boundary, may be associated with a 12-inch water line, which is present approximately 35 feet north of G-15, or previous discharges to Brush Creek (URS, 2004a). Although the water line does not cross any contaminated areas within Line 2, it does cross a south-trending 12-inch sanitary sewer line approximately 200 feet east of Brush Creek, which appears to contain wastewater from sites west of Line 2, potentially including the Contaminated Clothing Line (Tetra Tech, 2006b). Potentially contaminated water in the sewer piping could have leaked into the fill surrounding the water line and followed the fill toward Brush Creek in the past.

Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Groundwater flow at Line 2 is toward Brush Creek ranging from southwest to northwest (Figure 5.3-3). Given that the overburden aquifer is within the loess and glacial till composed predominantly of silty and sandy clay and silt and that the hydraulic gradient is assumed to be low, the groundwater flow velocity is expected to be slow within Line 2. However, where the glacial till has been eroded to the west, the velocity should be faster within the alluvium near Brush Creek. Vertical migration at the site is also limited by the generally tight clay lithology in the overburden.

As discussed in Table 5.3-1, a groundwater treatability study was conducted in 2007 and 2008 northwest of Building 2-05-1, in an area around well L2-TT-MW02, where historically the greatest RDX concentrations had been observed. DPT injection of a high-fructose corn syrup solution were completed around L2-TT-MW01, L2-TT-MW02, and JAW-72. Following the treatability study, concentrations of RDX in groundwater decreased; however, RDX concentrations were already on a decreasing trend at several of the wells even before the injection. At JAW-70 and JAW-71, RDX concentrations had been declining since approximately 2000, and at JAW-72, RDX concentrations had been declining since approximately 2006.

Natural attenuation mechanisms that are potentially active at Line 2 were evaluated. Natural attenuation includes various physical, chemical, or biological processes that under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. A weight-of-evidence approach was used for this evaluation.

The primary line of evidence that attenuation is occurring at a site is reduction over time in contaminant concentrations or mass, or both.

- In the north RDX plume, explosives were only detected at levels greater than their site characterization PALs in three shallow overburden monitoring wells during the latest sampling events (JAW-70, JAW-71, and JAW-72). RDX concentrations in these three wells show decreasing trends since late 2000 (Figure 5.3-7). Historically, the greatest concentrations of RDX were detected at overburden monitoring well L2-TT-MW02; however, concentrations have been less than the PAL since 2009 (Figure 5.3-7). This decrease in concentrations indicates that natural attenuation is occurring.
- In the south RDX plume, the trend graph for G-15 indicates that RDX concentrations have fluctuated over time. Between 2003 and 2006, a decreasing trend was observed, which was then following by an increasing trend since 2006 (Figure 5.3-8). Nevertheless, this southern plume appears stable and has not migrated downgradient. The southern RDX plume is laterally delineated by monitoring wells L2-MW10 and L2-MW11 and vertically bound by L2-MW8.

Anaerobic daughter products of RDX were detected at Line 2 in 2018. Low levels (< 5 to 16 J µg/L) of MNX, TNX, and DNX were detected at monitoring wells JAW-70 and JAW-71, providing evidence that anaerobic biodegradation of RDX is occurring in the Line 2 north RDX plume. MNX, TNX, and DNX have not been analyzed for at the south RDX plume. The presence of the amino-DNT isomers in groundwater may be byproducts of biodegradation of historical 2,6-DNT at the site.

Water quality parameters can be used to evaluate whether the geochemical conditions are conducive to biodegradation. During the current RI, groundwater in the impacted monitoring wells in the north RDX plume (JAW-70 and JAW-71) and the south RDX plume (G-15) was observed to be under aerobic and oxidizing conditions. DO concentrations were reported in groundwater at levels greater than 1 mg/L, and ORP values were reported at levels greater than +100 mV (Table 5.3-6). pH values were relatively neutral (between 6 and 7), which is favorable for biological activity. Under these geochemical conditions, aerobic biodegradation of methylene chloride would be favorable while anaerobic biodegradation of explosives, particularly RDX and TCE, would be less favorable. Nevertheless, the presence of anerobic RDX daughter products (MNX, TNX, and DNX) indicates that anaerobic biodegradation has occurred. On the contrary, no reductive degradation products of TCE were observed during the 1997 sampling event. However, TCE can also degrade via aerobic cometabolism and by abiotic means. RDX is also subject to abiotic degradation. Nitrobenzene can be used as a carbon source by microorganisms under variable redox conditions.

The physical natural attenuation processes are also likely helping to stabilize the plumes, given the very limited extent of the plumes. This is particularly true for the south RDX plume, which does not show decreasing concentration trends, but remains stable. The VOCs were observed only at slightly elevated concentrations and at only one well. While the explosives (RDX, 4-Amino-2,6-DNT, 2-Amino-4,6-DNT, and nitrobenzene) and VOCs in groundwater have relatively low sorption potential, they should be retarded somewhat as they sorb to the clay geology. Because the explosives have limited volatility (Table 4.2-1), they are unlikely to volatilize into soil gas at the water table interface, whereas the VOCs have high volatility.

5.3.6 Human Health Risk Assessment

An HHRA was prepared for Line 2 to evaluate potential current and future health risks and hazards from exposure to chemicals in site groundwater. Soil media is not included in the HHRA as it is not a component of this RI; the soil RI was conducted under OU-1. As discussed in Section 5.3.1.3, contaminants in soil were removed to meet their OU-1 RGs under multiple removal actions, with the exception of RDX at two areas. Surface water and sediment media are not included in the HHRA as perennial surface water features are not present at Line 2. The HHRA was conducted in accordance with the final UFP-QAPP (CH2M, 2017b), with the exception of some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final UFP-QAPP. The approach and methods used to conduct the HHRA are provided in Section 4.3.1. This section presents the CEM for Line 2 and provides the results of the four-step evaluation process comprised of:

- Data evaluation.
- Exposure assessment.
- Toxicity assessment.
- Risk characterization.

The results of the HHRA are used to determine if further action is warranted for groundwater at Line 2.

5.3.6.1 Conceptual Exposure Model

A description of Line 2, its operational history, previous investigations, and remedial actions are provided in Sections 5.3.1 and 5.3.2. The soil at Line 2 is addressed under the remedy for OU-1 (Leidos, 2018) and was not reevaluated in this HHRA.

Line 2 is used to load, assemble, and pack 120-mm ammunition and blank ammunition. The site consists of 31 buildings and covered walkways and includes equipment rooms, explosives magazines, and sump buildings (Tetra Tech, 2016). There are no perennial surface water features within the Line 2 site boundary. The site is closed to recreational activities; therefore, hunting is not permitted within the site boundary. Culverts are present at the site; therefore, potential groundwater exposures by future construction/utility workers are complete at Line 2.

Groundwater is not currently being used as a potable water source and there are no plans to use groundwater for potable purposes in the future; however, based on applicable CERCLA policy and guidance, groundwater at Line 2 is classified as Class IIB, a potential source of drinking water (USEPA, 1989). Therefore, the HHRA for Line 2 evaluates potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater.

The following potential current and future human receptors were identified in the HHRA for Line 2:

- **Current Site Workers.** Current site workers could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in active buildings at Line 2.
- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 2 and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within the Line 2 site.

- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 2 and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in future buildings.

As discussed in Section 4.3.1, potential exposures and risks and hazards to current and future site workers and future construction/utility workers are estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels and COCs are identified for a residential scenario. The human health CEM presenting potential exposure media, exposure points, receptors, and exposure routes is provided in Appendix A-4, Attachment 1 (Table 1) and depicted graphically in Figure 5.3-9.

5.3.6.2 Data Evaluation

Data Used in the HHRA

The analytical data used in the HHRA consists of groundwater samples collected at Line 2. Historical groundwater samples collected from 2003 to 2006 and recent samples collected in 2018 were used in the HHRA for Line 2. Historical groundwater samples were analyzed for explosives and metals. The 2018 groundwater samples were analyzed for explosives. The groundwater sampling conducted in 2018 addressed data gaps identified in the final CWWP (Tetra Tech, 2006b) and the final UFP-QAPP Packet 1 (CH2M, 2017b). Both reports documented that further investigation was warranted to refine the extent of explosives in groundwater, specifically RDX on the western side of Line 2. As discussed in the final UFP-QAPP site-specific worksheets (CH2M, 2017b), analysis of other analytes, including metals, was not warranted during the 2018 sampling event. Therefore, the explosives data from the groundwater samples collected in 2018 and the metals data from the groundwater samples collected from 2003 to 2006 were used in the HHRA. As stated in the UFP-QAPP (CH2M, 2017a), "Older data (i.e., data collected prior to 2012) may be used in the human health risk assessments if they are still representative of the site (i.e., groundwater flow is slow), chemicals have properties where there would not be a significant reduction in concentrations over time (e.g., metals), or data are conservative for site conditions." Potential soil sources to groundwater at Line 2 have been remediated, as described in Section 5.3.1.3. Due to a lack of continuing sources, historical concentrations in groundwater are expected to have remained stable or even decreased due to natural attenuation processes. Therefore, the assumptions in the final UFP-QAPP still hold. Samples collected prior to 2012 are considered representative of, or more conservative than, current conditions at Line 2.

The same groundwater data groupings for organic chemicals were used to evaluate a potable use scenario and the VI pathway because a separate data grouping was not needed for the VI pathway (that is, no multilevel wells are present at Line 2). A separate groundwater data grouping was used to evaluate a construction/utility worker scenario, assuming construction/utility workers could be exposed to groundwater encountered at depths up to 10 feet bgs. The following lists the number of chemicals analyzed and detected in groundwater at Line 2 (Table 5.3-7):

Table 5.3-7. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Groundwater (Onsite)		
Explosives	17	10
Metals	23	19

Table 5.3-7. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Groundwater (Offsite)		
Explosives	17	4
Metals	23	15

A description of the data groupings, including the number of groundwater samples in each data grouping, used in the HHRA is provided in Tables 5.3-8 and 5.3-9. The analytical dataset used in the HHRA is included as Appendix A-4, Attachment 2. The groundwater sampling locations included in the HHRA are depicted in Figure 5.3-10.

Screening Results for Site-Related Chemicals of Potential Concern and Naturally Occurring Chemicals

The approach and SLs used to select the COPCs (site-related COPCs or naturally occurring chemicals) are described in Section 4.3.1. The results of the COPC screening process for groundwater are provided in Appendix A-4, Attachment 1 (Tables 2.1 through 2.6) and summarized in Tables 5.3-10 and 5.3-11.

Table 5.3-10. Summary of COPCs for Line 2—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water (Onsite)				
Future Site Worker and Future Hypothetical Resident	2-amino-4,6-DNT	1/13	7.4	7.4
	4-amino-2,6-DNT	1/13	7.3	7.3
	HMX	4/13	0.053	160
	Nitrobenzene	1/13	14	14
	RDX	3/13	0.16	180
	Antimony	1/2	3.6	3.6
	Arsenic	7/23	5.4	44.9
	Barium	20/20	47.4	635
Groundwater to Indoor Air via Vapor Intrusion (Onsite)—no COPCs				
Shallow Groundwater in a Trench (<10 ft bgs) (Onsite)				
Future Construction/Utility Worker	2-Amino-4,6-DNT	1/13	7.4	7.4
	4-Amino-2,6-DNT	1/13	7.3	7.3
	HMX	4/13	0.053	160
	Nitrobenzene	1/13	14	14
	RDX	3/13	0.16	180
	Antimony	1/2	3.6	3.6
	Arsenic	7/22	5.4	44.9

Table 5.3-10. Summary of COPCs for Line 2—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
	Barium	19/19	47.4	635
Groundwater Used for Tap Water (Offsite)				
Future Site Worker and Future Hypothetical Resident	4-Amino-2,6-DNT	1/4	0.25	0.25
	HMX	2/4	0.088	250
	RDX	1/4	590	590
	Antimony	1/1	2.6	2.6
Groundwater to Indoor Air via Vapor Intrusion (Offsite)—no COPCs				
Shallow Groundwater in a Trench (<10 ft bgs) (Offsite)				
Future Construction/Utility Worker	4-Amino-2,6-DNT	1/3	0.25	0.25
	HMX	1/3	250	250
	RDX	1/3	590	590
	Antimony	1/1	2.6	2.6

Table 5.3-11. Summary of COPCs for Line 2—Naturally Occurring
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water (Onsite)				
Future Site Worker and Future Hypothetical Resident	Cadmium	3/20	0.2	0.72
	Chromium	8/20	0.55	25.6
Groundwater to Indoor Air via Vapor Intrusion (Onsite)—No COPCs				
Shallow Groundwater in a Trench (<10 ft bgs) (Onsite)				
Future Construction/Utility Worker	Cadmium	3/19	0.2	0.72
	Chromium	8/19	0.55	25.6
Groundwater Used for Tap Water (Offsite)				
Future Site Worker and Future Hypothetical Resident	Cadmium	1/2	0.49	0.49
	Chromium	1/2	0.79	0.79
Groundwater to Indoor Air via Vapor Intrusion (Offsite)—No COPCs				
Shallow Groundwater in a Trench (<10 ft bgs) (Offsite)				
Future Construction/Utility Worker	Cadmium	1/2	0.49	0.49
	Chromium	1/2	0.79	0.79

5.3.6.3 Exposure Assessment

Line 2 is currently active and buildings are present within the site boundary. A new facility is planned for construction at Line 2. The site is closed to recreational activities; therefore, hunting is not permitted within the site boundary. There are no potentially complete pathways for surface water and sediment because no perennial surface water features are present within Line 2. As previously discussed, groundwater is not currently being used as a potable water source; however, the HHRA for Line 2 evaluated potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater. Therefore, ingestion, dermal contact, and inhalation of household air (residents only) exposures to COPCs in groundwater were evaluated for future site workers and hypothetical residents. Inhalation exposures to indoor air from vapor intrusion of site groundwater are incomplete because no volatile chemicals were identified as VI COPCs in groundwater at Line 2. Culverts are located at Line 2; therefore, potential ingestion, dermal contact, and inhalation exposures to shallow groundwater in a trench were evaluated for future construction/utility workers. The potential exposure pathways quantified in the HHRA are included in Appendix A-4, Attachment 1 (Table 1) and in Figure 5.3-9. The following receptor scenarios were quantified in the HHRA for Line 2:

- Future site worker.
  - Groundwater (tap water) COPCs—ingestion and dermal contact.
- Future construction/utility worker.
  - Shallow groundwater (trench, 0 to 10 feet bgs) COPCs—incidental ingestion and dermal contact
- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion, dermal contact, and inhalation of volatiles in household air.

Risks and hazards for site workers and construction/utility workers were quantified in the HHRA because the estimated risks or hazards for a hypothetical residential scenario exceeded acceptable risk or hazard levels and COCs were identified for a residential scenario.

In accordance with USEPA guidance *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b), groundwater EPCs are typically calculated based on the data collected in the core of a plume. One RDX plume is present onsite at Line 2 and a small RDX plume is also located offsite adjacent to Brush Creek (Figure 5.3-10). Three monitoring wells are located within the core of the onsite plume and include L2-MW4, JAW-71, and JAW-70. Two monitoring wells are located within the core of the offsite plume and include L2-MW8 and G-15.

For groundwater, where a sufficient number of samples and detected concentrations are available, the UCL on the mean is selected as the EPC for these COPCs. However, for all COPCs for Line 2, fewer than eight samples or four detects were available in the plume datasets, so the MDC was selected as the EPC for each COPC. The groundwater EPCs used to estimate the daily intakes and ECs for groundwater are provided in Appendix A-4, Attachment 1 (Tables 3.1 through 3.4).

The exposure factors used in the daily intake and EC calculations for receptor scenarios are included in Appendix A-4, Attachment 1 (Tables 4.1 through 4.4). The primary references for the exposure factor values are the standard default exposure factors presented in the HHEM *Update of Standard Default Exposure Factors* (USEPA, 2014a).

One COPC (chromium) was identified as acting with a MMOA in site media. The analytical results for total chromium were evaluated using the hexavalent chromium SLs and toxicity values in the HHRA. The ADAFs and exposure assumptions used to calculate adjusted daily intakes for chromium are provided in Appendix A-4, Attachment 1 (Table 4 Supplement).

5.3.6.4 Toxicity Assessment

The oral toxicity values (CSFs and RfDs) and inhalation toxicity values (IURs and RfCs) used in the HHRA were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as provided in Section 4.3.1. Noncancer toxicity values for the COPCs identified at Line 2 are provided in Appendix A-4, Attachment 1 (Tables 5.1 and 5.2). Cancer toxicity values for the COPCs are provided in Appendix A-4, Attachment 1 (Tables 6.1 and 6.2).

5.3.6.5 Risk Characterization

The risk characterization for Line 2 was completed using a four-step process, as discussed in Section 4.3.1. The results of each step are discussed below.

Step 1: Total Combined Risks and Hazards from Site-Related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculating receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. The estimated risks and hazards for a hypothetical residential scenario are summarized in Table 5.3-12 for the onsite plume and in Table 5.3-13 for the offsite plume.

Table 5.3-12. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 2 (Onsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.1 and 9.1	Onsite Groundwater (Tap water) Line 2 Plumes	2-amino-4,6-DNT	7.4	NA	2
			4-amino-2,6-DNT	7.3	NA	2
			HMX	160	NA	0.1
			Nitrobenzene	14	NA	1
			RDX	180	NA	1
			Antimony	3.6	NA	0.3
			Arsenic	44.9	NA	5
			Barium	635	NA	0.1
			Cadmium	0.72	NA	0.2
			Chromium [c]	25.6	NA	0.4
			Total HI (Groundwater):		**NA**	**13**
Hypothetical Resident (Child)	7.2 and 9.2	Onsite Groundwater (Tap water) Line 2 Plumes	2-amino-4,6-DNT	7.4	NA	4
			4-amino-2,6-DNT	7.3	NA	4
			HMX	160	NA	0.2
			Nitrobenzene	14	NA	1
			RDX	180	NA	2
			Antimony	3.6	NA	0.5
			Arsenic	44.9	NA	7

Table 5.3-12. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 2 (Onsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
			Barium	635	NA	0.2
			Cadmium	0.72	NA	0.4
			Chromium [c]	25.6	NA	0.6
			Total HI (Groundwater):		**NA**	**20**
Hypothetical Resident (Adult/Child Aggregate)	7.3 and 9.3	Onsite Groundwater (Tap water) Line 2 Plumes	2-amino-4,6-DNT	7.4	NA	NA
			4-amino-2,6-DNT	7.3	NA	NA
			HMX	160	NA	NA
			Nitrobenzene	14	1E-04	NA
			RDX	180	2E-04	NA
			Antimony	3.6	NA	NA
			Arsenic	44.9	9E-04	NA
			Barium	635	NA	NA
			Cadmium	0.72	NA	NA
			Chromium [c]	25.6	7E-04	NA
			Total ELCR (Groundwater):		**2E-03**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] Chromium was evaluated as hexavalent chromium in the HHRA.

NA = not applicable

RME = reasonable maximum exposure

Table 5.3-13. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 2 (Offsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.4 and 9.4	Offsite Groundwater (Tap water) Line 2 Plumes	4-amino-2,6-DNT	0.25	NA	0.08
			HMX	250	NA	0.2
			RDX	590	NA	4

Table 5.3-13. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 2 (Offsite)

Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
			Antimony	2.6	NA	0.2
			Cadmium	0.49	NA	0.2
			Chromium [c]	0.79	NA	0.01
			Total HI (Groundwater):		**NA**	**5**
Hypothetical Resident (Child)	7.5 and 9.5	Offsite Groundwater (Tap water) Line 2 Plumes	4-amino-2,6-DNT	0.25	NA	0.1
			HMX	250	NA	0.2
			RDX	590	NA	7
			Antimony	2.6	NA	0.3
			Cadmium	0.49	NA	0.3
			Chromium [c]	0.79	NA	0.02
			Total HI (Groundwater):		**NA**	**8**
Hypothetical Resident (Adult/Child Aggregate)	7.6 and 9.6	Offsite Groundwater (Tap water) Line 2 Plumes	4-amino-2,6-DNT	0.25	NA	NA
			HMX	250	NA	NA
			RDX	590	6E-04	NA
			Antimony	2.6	NA	NA
			Cadmium	0.49	NA	NA
			Chromium [c]	0.79	2E-05	NA
			Total ELCR (Groundwater):		**6E-04**	**NA**

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] Chromium was evaluated as hexavalent chromium in the HHRA.

NA = not applicable

RME = reasonable maximum exposure

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculation of receptor-specific ELCRs and HIs for naturally occurring chemicals. Two COPCs (cadmium and chromium) were identified as naturally occurring chemicals in site groundwater at Line 2, as discussed in Section 5.3.4. The estimated risks and hazards for the naturally occurring chemicals in groundwater for a future hypothetical residential scenario are provided in Table 5.3-14 for the onsite plume and in Table 5.3-15 for the offsite plume. The naturally occurring chemicals are not used to identify the final COCs for Line 2 and are not discussed further in the HHRA after this step.

Table 5.3-14. Summary of Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 2 (Onsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.7 and 9.7	Onsite Groundwater (Tap water) Line 2 Plumes	Cadmium	0.72	NA	0.2
			Chromium [c]	25.6	NA	0.4
			Total HI (Groundwater):		**NA**	**0.6**
Hypothetical Resident (Child)	7.8 and 9.8	Onsite Groundwater (Tap water) Line 2 Plumes	Cadmium	0.72	NA	0.4
			Chromium [c]	25.6	NA	0.6
			Total HI (Groundwater):		**NA**	**1**
Hypothetical Resident (Adult/Child Aggregate)	7.9 and 9.9	Onsite Groundwater (Tap water) Line 2 Plumes	Cadmium	0.72	NA	NA
			Chromium [c]	25.6	7E-04	NA
			Total ELCR (Groundwater):		**7E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] Chromium was evaluated as hexavalent chromium in the HHRA.

NA = not applicable

RME = reasonable maximum exposure

Table 5.3-15. Summary of Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 2 (Offsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.10 and 9.10	Offsite Groundwater (Tap water) Line 2 Plumes	Cadmium	0.49	NA	0.2
			Chromium [c]	0.79	NA	0.01
			Total HI (Groundwater):		**NA**	**0.2**
Hypothetical Resident (Child)	7.11 and 9.11	Offsite Groundwater (Tap water) Line 2 Plumes	Cadmium	0.49	NA	0.3
			Chromium [c]	0.79	NA	0.02
			Total HI (Groundwater):		**NA**	**03**

Table 5.3-15. Summary of Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 2 (Offsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult/Child Aggregate)	7.12 and 9.12	Offsite Groundwater (Tap water) Line 2 Plumes	Cadmium	0.49	NA	NA
			Chromium [c]	0.79	2E-05	NA
			Total ELCR (Groundwater):		**2E-05**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] Chromium was evaluated as hexavalent chromium in the HHRA.

NA = not applicable

RME = reasonable maximum exposure

Step 3: Risk Characterization of Site-Related COPCs

Step 3 consists of calculating receptor-specific ELCRs and HIs associated with site-related COPCs. Eight COPCs (five explosives and three metals) were identified as site-related COPCs for onsite groundwater and four COPCs (three explosives and one metal) were identified as site-related COPCs for offsite groundwater. The estimated risks and hazards for site-related COPCs in groundwater for a future hypothetical resident are provided in Table 5.3-16 for the onsite plume and in Table 5.3-17 for the offsite plume.

Table 5.3-16. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 2 (Onsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
Site Worker	7.13 and 9.13	Onsite Groundwater(Tap water) Line 2 Plumes	2-amino-4,6-DNT	7.4	NA	0.6
			4-amino-2,6-DNT	7.3	NA	0.6
			HMX	160	NA	0.03
			Nitrobenzene	14	NA	0.06
			RDX	180	4E-05	0.4
			Antimony	3.6	NA	0.08
			Arsenic	44.9	2E-04	1
			Barium	635	NA	0.03
			Total ELCR and HI (Groundwater)[c]:		**3E-04**	**3**
Construction/ Utility Worker	7.14 and 9.14	Onsite Groundwater(Trench) Line 2 Plumes	2-amino-4,6-DNT	7.4	NA	0.01
			4-amino-2,6-DNT	7.3	NA	0.01
			HMX	160	NA	0.0003

Table 5.3-16. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 2 (Onsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
			Nitrobenzene	14	NA	1
			RDX	180	8E-09	0.0002
			Antimony	3.6	NA	0.003
			Arsenic	44.9	3E-08	0.02
			Barium	635	NA	0.002
			Total ELCR and HI (Groundwater):		**4E-07**	**1**
Hypothetical Resident (Adult)	7.15 and 9.15	Onsite Groundwater(Tap water) Line 2 Plumes	2-amino-4,6-DNT	7.4	NA	2
			4-amino-2,6-DNT	7.3	NA	2
			HMX	160	NA	0.1
			Nitrobenzene	14	NA	1
			RDX	180	NA	1
			Antimony	3.6	NA	0.3
			Arsenic	44.9	NA	5
			Barium	635	NA	0.1
			Total HI (Groundwater)[d]:		**NA**	**12**
Hypothetical Resident (Child)	7.16 and 9.16	Onsite Groundwater (Tap water) Line 2 Plumes	2-amino-4,6-DNT	7.4	NA	4
			4-amino-2,6-DNT	7.3	NA	4
			HMX	160	NA	0.2
			Nitrobenzene	14	NA	1
			RDX	180	NA	2
			Antimony	3.6	NA	0.5
			Arsenic	44.9	NA	7
			Barium	635	NA	0.2
			Total HI (Groundwater) [e]:		**NA**	**19**
Hypothetical Resident (Adult/Child Aggregate)	7.17 and 9.17	Onsite Groundwater (Tap water) Line 2 Plumes	2-amino-4,6-DNT	7.4	NA	NA
			4-amino-2,6-DNT	7.3	NA	NA
			HMX	160	NA	NA
			Nitrobenzene	14	1E-04	NA
			RDX	180	2E-04	NA
			Antimony	3.6	NA	NA

Table 5.3-16. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 2 (Onsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
			Arsenic	44.9	9E-04	NA
			Barium	635	NA	NA
				Total ELCR (Groundwater) [f]:	**1E-03**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater—micrograms per liter.

[c] The ELCR exceeds 1 × 10^{-4} (due to arsenic and RDX)—Appendix A-4, Attachment 1 (see Table 9.13).

[d] The HIs for hepatic (due to 2-amino-4,6-DNT, and 4-amino-2,6-DNT), cardiovascular and dermal (due to arsenic), and nervous system (due to nitrobenzene and RDX) exceed 1—Appendix A-4, Attachment 1 (see Table 9.15).

[e] The HIs for hepatic (due to 2-amino-4,6-DNT, 4-amino-2,6-DNT, and HMX), cardiovascular and dermal (due to arsenic), and nervous system (due to nitrobenzene and RDX) exceed 1—Appendix A-4, Attachment 1 (see Table 9.16).

[f] The ELCR exceeds 1 × 10^{-4} (due to arsenic, nitrobenzene, and RDX)—Appendix A-4, Attachment 1 (see Table 9.17).

NA = not applicable

RME = reasonable maximum exposure

Table 5.3-17. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 2 (Offsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
Site Worker	7.18 and 9.18	Offsite Groundwater (Tap water) Line 2 Plumes	4-amino-2,6-DNT	0.25	NA	0.02
			HMX	250	NA	0.04
			RDX	590	1E-04	1
			Antimony	2.6	NA	**0.06**
			Total ELCR and HI (Groundwater):		**1E-04**	**1**
Construction/ Utility Worker	7.19 and 9.19	Offsite Groundwater (Trench) Line 2 Plumes	4-amino-2,6-DNT	0.25	NA	0.0004
			HMX	250	NA	0.0007
			RDX	590	3E-08	0.0009
			Antimony	2.6	NA	0.002
			Total ELCR and HI (Groundwater):		**3E-08**	**0.004**
Hypothetical Resident (Adult)	7.20 and 9.20	Offsite Groundwater (Tap water)	4-amino-2,6-DNT	0.25	NA	0.08
			HMX	250	NA	0.2
			RDX	590	NA	4

Table 5.3-17. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 2 (Offsite)
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 2		
				EPC [b]	ELCR	HI
		Line 2 Plumes	Antimony	2.6	NA	0.2
			Total HI (Groundwater) [c]:		**NA**	**5**
Hypothetical Resident (Child)	7.21 and 9.21	Offsite Groundwater (Tap water) Line 2 Plumes	4-amino-2,6-DNT	0.25	NA	0.1
			HMX	250	NA	0.2
			RDX	590	NA	7
			Antimony	2.6	NA	0.3
			Total HI (Groundwater) [d]:		**NA**	**8**
Hypothetical Resident (Adult/Child Aggregate)	7.22 and 9.22	Offsite Groundwater (Tap water) Line 2 Plumes	4-amino-2,6-DNT	0.25	NA	NA
			HMX	250	NA	NA
			RDX	590	6E-04	NA
			Antimony	2.6	NA	NA
			Total ELCR (Groundwater) [e]:		**6E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater—micrograms per liter.

[c] The HI for nervous system (due to RDX) exceeds 1—Appendix A-4, Attachment 1 (see Table 9.20).

[d] The HI for nervous system (due to RDX) exceeds 1—Appendix A-4, Attachment 1 (see Table 9.21).

[e] The ELCR exceeds 1 × 10^{-4} (due to RDX)—Appendix A-4, Attachment 1 (see Table 9.22).

NA = not applicable

RME = reasonable maximum exposure

Step 4: Final COC Determination

For groundwater potable use by future hypothetical residents, the target organ–specific HIs exceeded USEPA's threshold of 1 and the cumulative ELCR exceeded USEPA's acceptable risk range (1 × 10^{-6} to 1 × 10^{-4}) due to the COPCs indicated below (Table 5.3-18):

Table 5.3-18. COPCs Exceeding USEPA Target Thresholds—Future Hypothetical Residents
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1 × 10^{-4}
Onsite Plume: 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, arsenic, nitrobenzene, and RDX **Offsite Plume**: RDX	**Onsite Plume**: Arsenic, nitrobenzene, and RDX **Offsite Plume**: RDX

These chemicals were identified as COCs in groundwater for future hypothetical residents. Therefore, potential exposures and risks and hazards were also estimated for potential site workers and construction/utility workers (summarized in Tables 5.3-13 and 5.3-14).

For potable use of groundwater by future site workers, the target organ–specific HIs did not exceed USEPA's acceptable HI of 1 but the cumulative ELCR exceeded USEPA's acceptable risk range for the onsite plume due to arsenic and RDX.

For contact with shallow groundwater by future construction/utility workers, the cumulative ELCR and HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1, respectively, and no COCs were identified for this receptor.

In summary, the following COCs were identified for groundwater, as presented in Appendix A-4, Attachment 1 tables (Table 5.3-19):

Table 5.3-19. Final COCs identified for Groundwater at Line 2
Iowa Army Ammunition Plant, Middletown, Iowa

COC	Onsite Plume		Offsite Plume
	Site Workers (Table 10.1)	**Hypothetical Residents (Tables 10.2–10.4)**	**Hypothetical Residents (Tables 10.5–10.7)**
2-amino-4,6-DNT	—	X	—
4-amino-2,6-DNT	—	X	—
HMX	—	X	—
Nitrobenzene	—	X	—
RDX	X	X	X
Arsenic	X	X	—

5.3.6.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. The general uncertainties associated with the HHRAs for the sites in this RI report are provided in Section 4.3.1. This section provides additional site-specific uncertainties associated with the HHRA for Line 2 that are not included in Section 4.3.1.

Hazard estimates for 2-amino-4,6-DNT and 4-amino-2,6-DNT could be over- or underestimated because screening RfDs were used in the risk calculations. As stated in the PPRTV documents for 2-amino-4,6-DNT and 4-amino-2,6-DNT (USEPA, 2022a, 2022b),

> It is inappropriate to derive a subchronic or chronic provisional RfD for [2-amino-4,6-dinitrotoluene or 4-amino-2,6-dinitrotoluene]. However, information is available which, although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors… Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of a supplemental screening toxicity value than for a value presented in the body of the assessment.

Chemicals that were 100 percent not detected in groundwater were not included in the COPC identification process; however, they were evaluated in a separate screening to determine if elevated nondetected results were present in groundwater. The detailed analysis of the nondetected chemicals at Line 2 is provided in Appendix A-4, Attachment 3. In summary, two explosives (2,6-DNT and 2-nitrotoluene) had RLs greater than the SLs; however, only 2,6-DNT had DLs greater than the SL. Two metals (cobalt and thallium) had DLs greater than SLs at Line 2. Although the RLs and/or DLs for these nondetect chemicals are greater than the SLs, based on the adequacy of the RLs and comparison to historically detected chemicals in groundwater at IAAAP, further consideration of the nondetect chemicals does not appear warranted in the Line 2 HHRA.

5.3.6.7 Summary of HHRA

An HHRA was prepared for Line 2 to evaluate potential current and future health risks from exposure to chemicals in site groundwater. Line 2 is currently active, and buildings are present on the site. The site is closed to recreational activities and hunting is not permitted within the site boundary. Additionally, there are no perennial surface water bodies within the Line 2 site boundary.

The following potential human receptors were identified in the HHRA for Line 2:

- **Current Site Workers.** Current site workers could be exposed to indoor air (if impacted by VOCs migrating from groundwater) in active buildings at Line 2.
- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 2 and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within the Line 2 site.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 2 and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in future residences.

Potential exposures and risks to future site workers and construction/utility workers were estimated in the HHRA since estimated risks and hazards for a hypothetical residential scenario exceeded acceptable levels and COCs were identified for a residential scenario.

The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are as follows:

- Onsite groundwater (potable use and trench scenario):
  - Naturally occurring: cadmium and chromium.
  - Site-related: antimony, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, nitrobenzene, RDX, arsenic, and barium.
- Onsite groundwater (vapor intrusion): None
- Offsite groundwater (potable use and trench scenario):
  - Naturally occurring: cadmium and chromium.
  - Site-related: antimony, 4-amino-2,6-DNT, HMX, and RDX.
- Offsite groundwater (vapor intrusion): None

The risk characterization for Line 2 was completed using a four-step process, as discussed in Section 4.3.1. Step 1 presents the total combined risks and hazards from site-related COPCs and naturally occurring chemicals, as summarized in Tables 5.3-9 and 5.3-10. Step 2 presents the risks and hazards from naturally occurring chemicals, as summarized in Tables 5.3-11 and 5.3-12. Step 3 presents the risks and hazards from site-related COPCs, as summarized in Tables 5.3-13 and 5.3-14.

Unacceptable groundwater risks and hazards were identified for hypothetical residents, and ; the following final COCs were identified for groundwater: 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, nitrobenzene, RDX, and arsenic in onsite groundwater and RDX in offsite groundwater. Therefore, these analytes were identified as COCs for future hypothetical residents, and groundwater risks and hazards were estimated for future site workers and construction/utility workers. Two analytes (arsenic and RDX) were identified as COCs in onsite groundwater for future site workers, while no COCs were identified in offsite groundwater for future site workers. Additionally, no COCs were identified in groundwater for future construction/utility workers.

In summary, the following COCs were identified for groundwater (Table 5.3-20):

Table 5.3-20. Final COCs for Line 2 Groundwater
Iowa Army Ammunition Plant, Middletown, Iowa

Future Site Worker	Future Construction/Utility Worker	Future Hypothetical Resident
Onsite Groundwater		
Arsenic RDX	None	Arsenic 2-amino-4,6-DNT 4-amino-2,6-DNT HMX Nitrobenzene RDX
Offsite Groundwater		
None	None	RDX

5.3.7 Ecological Risk Assessment

The ERA for groundwater at Line 2 is presented herein, beginning with Step 1 of the ERA process (to determine whether there are complete exposure pathways). Soil at the Line 2 is already addressed under the remedy for OU-1. There are no perennial surface water features within the Line 2 boundary, so as a result, there are no complete exposure pathways for sediment or surface water. Brush Creek is located approximately 200 feet west of Line 2; surface water and sediment from this feature were evaluated during the watershed ERA (CH2M, 2022). A summary of the Line 2 relationship with the Brush Creek watershed is discussed in the watershed ERA (CH2M, 2022) and included in Appendix I.

Groundwater is present onsite, but ecological receptors are not exposed directly to groundwater; nevertheless, groundwater is a transport medium, and contaminated groundwater has potential to migrate to and discharge to surface water bodies. Although there are ditches onsite for drainage purposes, these are not perennial waterbodies and do not provide suitable habitat for ecological receptors. Furthermore, as previously noted, there is no connectivity between the ditch and groundwater. Given the lack of perennial surface water bodies on Line 2, the groundwater-to-surface-water exposure pathway is incomplete. Because there are no complete exposure pathways for ecological receptors for Line 2, no ecological adverse effects are likely. Therefore, no additional analyses from an ecological perspective are warranted.

5.3.8 Conclusions and Recommendations

An RI was conducted for Line 2 to refine the nature and extent of contamination in groundwater from historical activities and assess for potential unacceptable risk to human health and the environment. Soil at this site was addressed under the remedial action for OU-1 and is not covered under this RI for OU-6. Analytical data available for groundwater at Line 2 includes VOCs, SVOCs, PAHs, PCBs, pesticides, explosives, and metals. Of these, only explosives were identified as site-related chemicals of interest based on historical site operations and a comparison of concentration data to site characterization PALs (listed in Appendix F) and BTVs.

During the most recent groundwater monitoring event, in 2018, only RDX, 2-amino-4,6-DNT, 4-amino-2,6-DNT, nitrobenzene, iron, and manganese exceeded their site characterization PALs and available BTVs. Explosives contamination is present as two plumes, a larger north plume and a smaller south plume. The north RDX plume is present downgradient of melt Building 2-05-2, while the south RDX plume is located outside of the Line 2 site boundary to the southwest, along Brush Creek. Although the south plume is located outside of the Line 2 boundary, it has been administratively included with Line 2 due to its proximity. During the most recent sampling event in 2018, the greatest concentrations of RDX were observed at JAW-70 (180 J µg/L) within Line 2 and at G-15 (72 µg/L) along Brush Creek. The explosives plumes are laterally and vertically delineated. Both iron and manganese in groundwater at Line 2 are considered to be associated with the 2007–2009 treatability study, which enhanced reducing conditions in groundwater, and are not site-related.

An HHRA and an ERA were conducted to quantify potential risks to human health and the environment from exposure to contaminants at the Line 2. The following conclusions were made based on the risk assessments:

The HHRA identified potential unacceptable risks for the following media and receptors:

- Future hypothetical resident: For groundwater, potential unacceptable risks and hazards were identified from exposure to 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, nitrobenzene, RDX, and arsenic. Therefore, these analytes were identified as COCs for future hypothetical residents.
- Future site workers: For groundwater, potential unacceptable risks and hazards were identified from exposure to arsenic and RDX.
- Future construction/utility workers: No potential unacceptable risks or hazards were identified for exposure to groundwater.
- The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 2.

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs (RDX, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, nitrobenzene, and arsenic) in groundwater at Line 2. It is recommended that an FS be conducted under OU-6 to evaluate remedial alternatives to address the unacceptable risks in groundwater at Line 2 (IAAP-002G). When remedial alternatives are developed, the FS should consider ongoing site operations and the reasonably foreseeable future land use for this area.

5.4 IAAP-003G_Line 3 Ammo LAP (Artillery) Groundwater (19105.1005)

This subsection summarizes the RI activities conducted at Line 3. This report documents the RI for groundwater at Line 3 (IAAP-003G). Soil is addressed under the remedy for OU-1 (IAAP-003) (Leidos, 2018). There are no perennial surface water features within the Line 3 boundary.

5.4.1 Background

5.4.1.1 Site Description

Line 3 is an approximately 149-acre active site in the central portion of IAAAP located between Lines 9, 6, and 7 and Brush Creek (Figure 5.4-1). Line 3 historically consisted of 56 buildings and covered walkways comprising equipment rooms, explosives magazines, sump buildings, melt buildings, and two process water treatment facilities (Shaw, 2004b). More than 30 buildings have been demolished as part of IAAAP's facility demolition plan (Figure 5.4-1; IAAAP, 2023). A new facility is planned for construction at Line 3. Grass-covered areas and roadways surround the remaining buildings, and two railroad tracks run north–south within the site boundary. Line 3 is in the Brush Creek watershed.

5.4.1.2 Operational History

Line 3 began operating as a production line when the IAAAP was constructed, in 1941, and underwent a temporary shutdown period from 1945 to 1949 (JAYCOR, 1996). Melt Building 3-05-1 was largely destroyed by an explosion in March 1942 and was reconstructed with a single continuous melt unit. Operations at Line 3 included the production of shells (which used poured TNT); screening of propellant powder; production of ammonium nitrate (a commercial grade fertilizer) (Shaw, 2004b); melting of Composition B (TNT and RDX) and other binary explosives; and the loading, assembling, and packing of a range of munitions until much of the production was moved to Line 1, after September 1976. Line 3 was largely inactive, except for mine production until 1978 and "demilling" activities in 1979 (demilling refers to the demilitarization of leftover explosive devices in various stages of assembly). Production of new munitions commenced in 1979 and continued until 1992, when operations ceased and the line was placed in standby status for several years. Since then, the line has been used for production of mine-clearing line charge and melt-pour of Stinger warheads.

Between 1977 and approximately 1985, metal-cleaning operations were also conducted; these included using several stainless-steel dip tanks in which ammunition casings were immersed in a sulfuric acid/hydrochloric acid bath, followed by a chromic acid bath, and then rinsed with water. Hexavalent chromium was treated with sulfite to reduce the chromium to the trivalent form (USATHAMA, 1980). The metal treatment process also included brass plating (JAYCOR, 1994a).

From 1988 through 1989, Line 3 was inspected, and recommendations were made for contamination removal. General explosives contamination was noted around the washdown operations, particularly those areas located around the melt buildings and back lines. Historical releases at Line 3 may have occurred at the two melt buildings (3-05-1 and 3-05-2; Figure 5.4-1) located in the center of the site, which have been the areas of greatest waste volume. Explosives-contaminated wastewater was generated at the melt buildings when spilled explosives were washed from floors and equipment. Building 3-70-3 was constructed in 1978 and was used for treatment of industrial waste (Shaw, 2004b). A closed-loop pinkwater-recycling system, which included settling tanks, filtration, and carbon adsorption, was installed in 1998. The process water from Line 3 was stored in one of two influent holding tanks as it was generated. The contaminated water was treated and discharged intermittently as each tank approached approximately 1,200 gallons or the water could be recirculated for reuse. When not recycled, the treated effluent was periodically discharged through ditches to Brush Creek from permitted NPDES outfalls (32 and 33) (URS, 2004a). Outfall 32 is still included in the current (2020) NPDES permit (Permit 2900900) for IAAAP; the outfall is permitted to discharge effluent with explosives with a 30-day average of 0.75 mg/L and daily maximum discharge of 2.25 mg/L for RDX + HMX and with a 30-day average of 0.33 mg/L and daily maximum discharge of 0.91 mg/L for TNT (Figure 1-2). During an explosion at Building 3-05-1 on March 14, 2005, up to 55,000 gallons (approximate volume of the basement at the building) of nontreated wastewater was discharged.

5.4.1.3 Previous Investigations and Remedial Actions

Numerous investigations have been conducted at IAAAP since the 1980s. Table 5.4-1 summarizes the previous investigations and remedial actions conducted at Line 3, including conclusions and recommendations. There are no perennial surface water features within the site boundaries. However, results from surface water and sediment samples collected from the intermittent features outside the site boundary are discussed in Table 5.4-1 to support the CSM. Similarly, although soil at Line 3 has already been addressed under OU-1, previous investigations for soil are also presented in Table 5.4-1 to support the CSM.

This report summarizes the RI for groundwater at Line 3 (IAAP-003G). Previous investigations pertinent to the RI for groundwater are listed in Table 5.4-2; additional details on these investigations (including a more-detailed description of work completed as well as work not pertinent to this RI) are included in Table 5.4-1. Previous groundwater sampling locations are shown on Figure 5.4-2.

Table 5.4-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	A 1988 release of contaminated wastewater from the sump next to Building 3-05-01 was identified. The predominant wastes for this area were assumed to be explosives (TNT, PBX, RDX, and Composition B). It was recommended that sampling be conducted to determine the presence or absence of the chemicals used at Line 3A.
Facility-wide Site Inspection (JAYCOR, 1992)	No groundwater samples were collected during the facility-wide site inspection. It was recommended that further investigation for Line 3 be included in the RI.
Facility-wide Phase I RI (JAYCOR, 1993a, 1993b)	Groundwater samples were collected from six piezometers and analyzed for explosives. Three explosives (HMX, RDX, and 2,4-DNT) were detected in one sample (R03PZ2701).
Follow-on RI (JAYCOR, 1996)	Groundwater samples were collected from six new monitoring wells and analyzed for metals and explosives. In a subsequent event, groundwater samples were collected from monitoring wells JAW-53, JAW-55, and JAW-56 and analyzed for VOCs. Explosives were detected in groundwater samples from two monitoring wells and one piezometer, with a maximum concentration of 2,110 µg/L. Groundwater samples from four monitoring wells had lead concentrations ranging from 1.0 to 10 µg/L. VOCs were not detected in any of the follow-on groundwater samples.
Periodic Groundwater Monitoring (multiple reports)	Groundwater samples were collected from up to 13 wells during multiple sampling events between 1994 and 2008. Explosives were detected in wells screened in the shallow zones of the overburden aquifer and in shallow bedrock. One SVOC detected sporadically across the site in 1997 was attributed to the sampling method/equipment. One VOC, methylene chloride, which exceeded the screening level in 1997, was attributed to laboratory contamination. Three metals detected at levels greater than SLs in 1997 were attributed to metals-contaminated acid at the laboratory.

Table 5.4-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Supplemental Groundwater RI (MWH, 2001)	Groundwater samples were collected from five new monitoring wells and three existing wells and analyzed for explosives, TAL metals, VOCs, SVOCs, and groundwater quality parameters. Explosives and bis(2-ethylhexy)phthalate were detected at levels greater than screening criteria. It was concluded that the lateral extent of explosives contamination at Line 3 was limited to a small area near two wells (JAW55 and H16A) and had not reached Brush Creek. Explosives contamination was present primarily in shallow groundwater; however, exceedances were observed in deep well H16A. It was concluded that this detection may have been result of the well drilling and installation process, and continued monitoring should determine whether explosives actually are present.
Feasibility Study Data Collection (URS, 2004b)	Groundwater samples were collected from 20 temporary wells in the vicinity of Brush Creek and analyzed for explosives. Groundwater samples were also collected from two new monitoring wells within the intermediate overburden aquifer and sampled for explosives, SVOCs, metals, and natural attenuation parameters. A small explosives plume, consisting primarily of RDX and HMX, was observed around shallow monitoring well JAW-54. The vertical extent of the plume appeared to be restricted to the shallow aquifer zone. No metals were detected at levels greater than their MCLs. Groundwater flow and contaminant fate and transport models were developed. The models predicted that explosives concentrations in groundwater should continue to decline over time due to the naturally occurring processes and that the plume would not migrate to Brush Creek. The initial natural attenuation evaluation indicated natural attenuation processes may be significant for the Line 3 RDX plume, as concentrations and mass have decreased over time, RDX degradation products were detected in groundwater, and geochemical conditions were favorable for anaerobic biodegradation.
Comprehensive Watersheds Evaluation and Supplemental Data Collection (Tetra Tech, 2006b)	The work plan concluded that groundwater contamination had been adequately characterized, and no further groundwater sampling was recommended.

As part of the previous investigations under OU-1, TNT, 2,4-DNT, RDX, lead, arsenic, copper, antimony, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenz[ah]anthracene, and indeno[1,2,3-3,d]pyrene were identified as COCs at Line 3 (Tetra Tech, 2009a). Of these, TNT, 2,4-DNT, RDX, lead, arsenic, copper, and antimony were identified as contributing to excess human health or ecological risk, and soil excavation at 35 areas (Figure 5.4-1) was conducted in 2006 to address risks associated with these chemicals. Following the excavations, confirmation sampling results indicated remaining soil concentrations were less than OU-1 remedial goals, including those based on leachability, with two exceptions. Contaminated soil along the east wall of an excavation located south of Building 3-05-1 could not be removed without destroying utilities. Contaminated soil along the west wall of an excavation located south of Building 3-06-1 could not be removed without undermining the foundation of the building (USACE-Baltimore, 2016). Because soil was remediated to its leachability goals (aside from the two exceptions), the sources to groundwater in the removal areas have been addressed. Line 3 is also subject to OU-1 LUCs (Leidos, 2019).

Additional soil investigation was conducted at Line 3 in 2022 to determine if contaminated soil exists beneath recently demolished buildings and delineate the contamination in vadose zone soil that exceeds OU-1 RGs (TAC, 2022). The IAAAP is currently undergoing a modernization effort involving the demolition of numerous buildings throughout the Plant. The analytical results will be used to support future remedial design for soil contaminants under OU-1, and would be considered when developing the FS for OU-6, if a new soil source to groundwater was identified.

5.4.2 2018–2020 Remedial Investigation Activities

Additional field work was conducted at Line 3 to resolve data gaps and complete the RI for groundwater. As documented in the final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 2)* (CH2M, 2018a), no groundwater data existed at Building 3-10, where soil excavations occurred as part of prior remedial actions (Figure 5.4-1). To address this data gap, groundwater samples were collected from three DPT borings advanced downgradient of Building 3-10 and analyzed for explosives (Figure 5.4-2). As discussed in the final UFP-QAPP (CH2M, 2018a), no additional groundwater sampling was warranted for the northern explosives plume at Line 3 since that plume is laterally and vertically delineated. Fieldwork completed at Line 3 was conducted in accordance with the UFP-QAPP (CH2M, 2018a).

Between July 13 and July 20, 2018, groundwater samples were collected from three DPT borings (L3-DP01-18, L3-DP02-18, and L3-DP03-18) at Line 3 with the following data objective: Three direct-push sample locations were installed east of Building 3-10 to assess explosives concentration of groundwater downgradient of historical soil excavations, as well as potential vertical migration.

Prior to sample collection, the three borings were drilled to 50 feet bgs and continuous soil samples were collected for geologic logging and to assess for water-bearing zones; boring logs are provided in Appendix C. A DPT groundwater sample was collected at each boring location from the shallow overburden zone between depths of 15 and 38 feet bgs and sampled using a screen point sampler and peristaltic pump. Groundwater samples were submitted for explosives analysis by Method SW8330A. Data were managed and validated as discussed in Section 3.3. Laboratory reports are provided in Appendix B.

The boreholes were abandoned after sampling was complete. All IDW generated during activities (soil and purge water) was disposed of in accordance with management activities discussed in Section 3.2.9. Waste management documentation is provided in Appendix D.

Contingency monitoring wells were also proposed for consideration in the final UFP-QAPP (CH2M, 2018a) if elevated explosives concentrations were observed in the DPT groundwater samples. However, these contingency locations were not warranted as there were no explosives detected in any of the borings at concentrations greater than their site characterization PALs (see Section 5.4.4).

5.4.3 Environmental Setting

5.4.3.1 Topography and Surface Drainage

The topography of Line 3 slopes to the south and southeast. Surface drainage discharges into one of three intermittent tributaries of Brush Creek. At the far north of the site, drainage ditches (approximately less than 3 feet deep) discharge to an eastward-flowing intermittent tributary that joins Brush Creek approximately 1,500 feet east of the site. Surface drainage and NPDES discharges at the center of the site flow into an intermittent tributary that joins Brush Creek over 1,600 feet east of the site. The ditches that feed this tributary are up to approximately 3 feet deep. In the southern portion of the site, south-trending ditches (less than 3 feet deep) discharge into an intermittent tributary, which joins Brush Creek approximately 2,300 feet southeast of the southern end of Line 3, near the southwest corner of Line 2.

5.4.3.2 Geology and Hydrogeology

The overburden at Line 3 is characterized by loess from the surface to approximately 4 to 6 feet bgs. The loess is underlain by till, which is characterized primarily as yellowish-brownish and gray mottled clayey silt. Soil borings indicate that a sand seam is present within the glacial till, above a dense clay, which appears to slope toward Brush Creek (JAYCOR, 1996). Bedrock composed of the shale and limestone of the upper Warsaw Formation is encountered at 109.5 feet bgs (Figure 2-7).

Groundwater occurs in the overburden at depths ranging from less than 1 foot bgs to approximately 8 feet bgs, with the highest groundwater levels occurring in the spring. The most recent groundwater gauging event occurred in May 2017; these water-level measurements are depicted on Figure 5.4-3. Bedrock groundwater has historically been measured over 10 feet bgs. The groundwater flow direction at Line 3 varies from the east to the southeast toward Brush Creek (Figure 5.4-3). Horizontal hydraulic gradients are generally low, having been historically measured between 0.0022 and 0.011 foot per foot. Based on the results of slug tests conducted at site monitoring wells, hydraulic conductivities (*K* values) are estimated from 0.0038 to 0.5 feet/day in the overburden groundwater unit (CH2M, 2018a).

5.4.4 Nature and Extent of Contamination

This subsection describes the nature and extent of contamination at Line 3. Soil has been addressed under OU-1 but is discussed briefly to inform the CSM for a potential groundwater contaminant source. There are no perennial surface water features associated with this site.

The source of contamination at Line 3 is attributed to historical explosives LAP operations and metal treatment operations at site buildings and sumps. The areas with the greatest volume of explosives wastewater occurred at the two melt buildings (3-05-1 and 3-05-2; Figure 5.4-1) located in the center of the site. As discussed in Section 5.4.1.2, a known release occurred during an explosion at Building 3-05-1 on March 14, 2005, during which up to 55,000 gallons (approximate volume of the basement of the building) of nontreated wastewater was discharged. Other potential release sources from normal operations include explosives-contaminated wastewater from sump overflows, solvent and paint remover wastes from paint-stripping and renovation activities, contaminated wastewater from production room washdowns onto the ground or into nearby drainageways, spills at materials receiving docks, and dust releases from open windows and doors (Tetra Tech, 2009a). The wastewater generated from metal-cleaning processes was discharged to the wastewater treatment plant at Line 3 in Buildings 3-163-1 and 3-163-2 (JAYCOR, 1994a).

5.4.4.1 Groundwater

Groundwater samples have been collected at Line 3 as part of several investigations between 1992 and 2018. Twelve overburden monitoring wells and one bedrock monitoring well are present at Line 3 (Figure 5.4-2). Historical groundwater samples were analyzed for VOCs, SVOCs, explosives, and metals. Based on the historical site use, COCs identified in soil, and groundwater analytical data collected during the JAYCOR RI (JAYCOR, 1996) and from monitoring events conducted through 2008, chemicals of interest in groundwater at Line 3 are explosives and metals.

During the current RI, groundwater samples were collected at Line 3 from three DPT borings near Building 3-10 (Figure 5.4-2). Groundwater in the northern portion of the site was sampled during previous RI monitoring events (Table 5.4-1). Table 5.4-3 presents the concentrations of chemicals detected in groundwater samples during the most recent (2000–2018) sampling events. Statistical summary tables of the analytical results used in the HHRA are included in Section 5.4.6. Summary tables of all the analytical results (including nondetects) from the 2018 RI activities are provided in Appendix G. Summary tables of all historical analytical results from Line 3 are provided in Appendix H.

VOCs

Five VOCs have been detected in groundwater at Line 3 (Appendix H). In 2000 (the last sampling event in which VOCs were analyzed), the only VOC detected in groundwater was 1,1,1-trichloroethane (TCA). Concentrations of 1,1,1-TCA did not exceed the site characterization PAL (Table 5.4-3).

SVOCs

Five SVOCs have been detected in groundwater at Line 3 (Appendix H). Between 2000 and 2003 (the last sampling event in which SVOCs and PAHs were analyzed), 1,2,4-trichlorobenzene, diethyl phthalate, 1,4-oxathiane, and bis[2-ethylhexyl]phthalate were detected in groundwater. Only bis[2-ethylhexyl]phthalate was detected at levels greater than its site characterization PAL in wells 16-B, 16-C, 16-D, JAW-53, JAW-54, JAW-55, JAW-56, JAW-57, and JAW-77. However, bis[2-ethylhexyl]phthalate exceeded its site characterization PAL in only the most recent samples collected from JAW-57 and JAW-77. In addition, bis[2-ethylhexyl]phthalate is a plasticizer that is used in many common products, including PVC, plastic syringes, and pipette tips. It is not known to have been used at IAAAP. Therefore, its presence is attributed to laboratory or sampling contamination.

Explosives

Between 2000 and 2018, 13 explosives were detected in groundwater at Line 3 (Table 5.4-3). Of these, only five explosives (2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX) exceeded their site characterization PALs. Since 2000, exceedances of these explosives have been observed in only one shallow overburden monitoring well, JAW-54, and 2-6-DNT was detected in only one sample in 2004 but was not detected in 2000 through 2003 or in the 2005 or 2006 samples (Table 5.4-3). JAW-54 is located near the soil removal areas and former sumps associated with melt Building 3-05-01 (Figure 5.4-1). Explosives were not detected, or concentrations were less than the PALs, in all shallow overburden monitoring wells surrounding JAW-54 (JAW-53, JAW-54, JAW-57, and JAW-77) and in downgradient DPT samples borings (L3-DP02, L3-DP04, and L3-DP05), as shown on Figure 5.4-4. No explosives were detected in the intermediate overburden well (L3-MW-01) that is adjacent to JAW-54 or in the deeper cross-gradient/downgradient wells (L3-MW2 and 16-A).

Groundwater samples were collected from three DPT borings east (downgradient) of Building 3-10 in 2018. Low levels of four explosives (1,3,5-TNB, HMX, nitrobenzene, and RDX) were detected in two of the DPT groundwater samples (L3-DP01-18 and L3-DP02-18). However, concentrations were orders of magnitude less than the site characterization PALs (Table 5.4-3). Therefore, historical operations at Building 3-10 did not impact groundwater in a manner that would warrant further investigation.

Explosives contamination in groundwater at Line 3 is present as a small plume near Building 3-05-1 within the shallow overburden aquifer. The lateral and vertical extent of contamination is limited.

Metals

Between 2000 and 2004 (the last sampling event in which metals were analyzed), 13 metals were detected at Line 3 (Table 5.4-3). Of these, only one metal (cadmium) was detected at a level greater than its site characterization PAL and BTV (if available) in groundwater. Cadmium slightly exceeded its PAL (15 µg/L) and BTV (18.05 µg/L) at one location, JAW-57, in 2002 with a concentration of 47.8 µg/L. However, cadmium was not detected (5 U µg/L) in the same well in the subsequent monitoring event in 2003. Cadmium was also not detected at levels greater than its PAL and BTV during earlier sampling events in 2000 and 2001.

Concentrations of some metals may be naturally elevated in the environment, and may not indicate a CERCLA-regulated release. Based upon a historical record review, chemicals used at Line 3 included compounds of aluminum, chromium, lead, copper, and silver (Shaw, 2005a). Several metals (such as arsenic, barium, chromium, and manganese) were detected at Line 3 at concentrations less than their BTVs and are therefore considered to be consistent with background and naturally occurring. Although antimony was reported at a level greater than its BTV of 2.22 µg/L, it is also considered to be consistent with background and naturally occurring. In 2004, antimony exceedances were only observed in one monitoring well, JAW-54, at a concentration of 3 B µg/L (Appendix H). This concentration was B-qualified, which indicates that antimony was also detected in the associated method and/or calibration blank and this concentration is likely biased high. The only other detection of antimony in this well occurred in 1995 and was reported at a concentration less than the BTV. Antimony was not detected in this well, at an RL less than the BTV, during several other monitoring events. There is no reported use of antimony at Line 3.

5.4.5 Fate and Transport

This section discusses the fate and transport of site-related chemicals of interest at Line 3. This includes chemicals that exceeded both their site characterization PAL and BTV (if available) during the last sampling event in which those chemicals were analyzed. In groundwater, potential site-related chemicals of interest include explosives (2,4-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX). As noted previously, 2-6-DNT was detected in JAW-54 at a concentration greater than the site characterization PAL in 2004 but was not detected in 2000 through 2003 or in the 2005 or 2006 samples (Table 5.4-3). Although bis(2-ethylhexyl)phthalate was detected in groundwater at levels greater than its site characterization PAL, it is not considered to be a site-related chemical. It is not known to have been used at IAAAP and its presence is attributed to laboratory or sampling contamination. Fate and transport characteristics for chemicals of interest are described in Section 4.2.

Line 3 is primarily grass covered with few buildings and a few roads remaining, which lead to the demolished building footprints. The IAAAP site falls within the Brush Creek watershed (Figure 2-1). Surface runoff in the northern portion of the site moves toward an eastward-flowing intermittent tributary that joins Brush Creek approximately 1,500 feet east of the site. Surface runoff in the central portion of the site moves toward an intermittent tributary that joins Brush Creek over 1,600 feet east of the site. In the southern portion of the site, surface runoff moves southward toward an intermittent tributary that joins Brush Creek approximately 2,300 feet southeast of the southern end of Line 3. (Figure 5.4-3). Contaminants have entered groundwater at Line 3 due to the historical discharge of process water from buildings and sumps and the subsequent leaching of chemicals through unsaturated zone soil. The groundwater table at Line 3 is shallow, and groundwater in the overburden aquifer was encountered between 1 and 8 feet bgs during the current RI.

Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Groundwater at Line 3 flows to the east and southeast. Given that the overburden aquifer is composed predominantly of clays and that the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow. However, the velocity may be faster within the sand seams present with the aquifer.

Natural attenuation mechanisms that are potentially active at Line 3 were evaluated. Natural attenuation includes various physical, chemical, or biological processes that under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. A weight-of-evidence approach was used for this evaluation.

- The primary line of evidence that attenuation is occurring at a site is reduction over time in contaminant concentrations or mass or both. Explosives were recently detected at concentrations greater than their site characterization PALs in one monitoring well, JAW-54, at Line 3. Concentrations of explosives that were detected at levels greater than their site characterization PALs were plotted over time for this monitoring well (Figure 5.4-5). The trend graphs indicate that concentrations of RDX have steadily decreased in JAW-54. Concentrations of 2-amino-4,6-DNT and 4-amino-2,6-DNT have also decreased since their historical maximum concentrations in 1999. Similarly, concentrations of 2,4-DNT have overall declined since the historical maximum reported in 1997. This decrease in concentrations indicates that natural attenuation is occurring.
- Anaerobic daughter products of RDX were detected at JAW-54, indicating that natural attenuation was occurring in 2006 when these chemicals were last analyzed for. Low levels (< 5 µg/L) of MNX,

TNX, and DNX were detected at JAW-54 in 2006, providing evidence that anaerobic biodegradation of RDX is occurring in the Line 3 area.

- Physical natural attenuation processes are also likely helping to stabilize the plume, given the very limited extent of the plume. While the potentially site-related explosives (RDX, 2,4-DNT, 4-amino-2,6-DNT, and 2-amino-4,6-DNT) in groundwater have relatively low sorption potential, they should be retarded somewhat as they sorb to the clay geology. However, the explosives have limited volatility (Table 4.2-1) and therefore are unlikely to volatilize into soil gas at the water table interface.

5.4.6 Human Health Risk Assessment

An HHRA was prepared for Line 3 to evaluate potential current and future health risks and hazards from exposure to chemicals in site groundwater. Soil media are not included in the HHRA as soil is not a component of this RI; soil is addressed under the remedy for OU-1 (IAAP-003) (Leidos, 2018). As discussed in Section 5.4.1.3, contaminants in soil were removed to meet their OU-1 RGs under multiple removal actions, with the exception of RDX at two areas. Surface water and sediment media are not included in the HHRA since perennial surface water features are not present at Line 3. The HHRA was conducted in accordance with the final UFP-QAPP (CH2M, 2017a), with the exception of some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final UFP-QAPP. The approach and method used to conduct the HHRA are provided in Section 4.3.1. This section presents the CEM for Line 3 and provides the results of the four-step evaluation process composed of:

- Data evaluation.
- Exposure assessment.
- Toxicity assessment.
- Risk characterization.

The results of the HHRA are used to determine whether further action is warranted for groundwater at Line 3.

5.4.6.1 Conceptual Exposure Model

A description of Line 3, its operational history, previous investigations, and remedial actions are provided in Sections 5.4.1 and 5.4.2.

The site is active and includes grass-covered areas and roadways surrounding buildings that remain onsite. The site is not open to recreational activities; therefore, hunting is not permitted within the site boundary. There are no perennial surface water features within the Line 3 site boundary. Culverts are present at the site; therefore, potential groundwater exposures by future construction/utility workers are complete at Line 3.

Groundwater is not currently being used as a potable water source and there are no plans to use groundwater for potable purposes in the future; however, based on applicable CERCLA policy and guidance, groundwater at Line 3 is classified as Class IIB, a potential source of drinking water (USEPA, 1989). Therefore, the HHRA for Line 3 evaluates potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater.

There are no potentially complete exposure pathways under current site conditions. The following potential future human receptors were identified in the HHRA for Line 3:

- **Future Site Workers.** Future site workers could contact groundwater based on its potential future use as a drinking water source at Line 3 and could be exposed to indoor air (that may be impacted by volatile chemicals migrating from groundwater) in buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 3.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on its potential future use as a drinking water source at Line 3 and could be exposed to indoor air (that may be impacted by volatile chemicals migrating from groundwater) in buildings.

As discussed in Section 4.3.1, potential exposures and risks and hazards to future site workers and construction/utility workers are estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels and COCs are identified for a residential scenario. The human health CEM presenting potential exposure media, exposure points, receptors, and exposure routes is provided in Appendix A-5 Attachment 1 (Table 1) and depicted graphically in Figure 5.4-6.

5.4.6.2 Data Evaluation

Data Used in the HHRA

Historical groundwater samples collected from 2002 to 2008 and recent groundwater samples from 2018 were used in the HHRA for Line 3. The groundwater samples collected in 2002 through 2004 were analyzed for explosives, metals, and SVOCs; 2005 and 2006 samples were analyzed for explosives and an SVOC (1,4-oxathione); and 2007, 2008, and 2018 samples were analyzed for explosives. As stated in the UFP-QAPP (CH2M, 2017a), "Older data (i.e., data collected prior to 2012) may be used in the human health risk assessments if they are still representative of the site (i.e., groundwater flow is slow), chemicals have properties where there would not be a significant reduction in concentrations over time (e.g., metals), or data are conservative for site conditions." Potential soil sources to groundwater at Line 3 have been remediated, as described in Section 5.4.1.3. Due to a lack of continuing sources, historical concentrations in groundwater are expected to have remained stable or even decreased due to natural attenuation processes. Therefore, the assumptions in the final UFP-QAPP still hold. Samples collected prior to 2012 are considered representative of, or more conservative than, current conditions at Line 3.

A total of 44 groundwater samples were used to evaluate potential exposures for both a potable use scenario and the VI pathway. The groundwater samples were not collected at multilevel wells; therefore, a separate data grouping (based on shallow groundwater only) was not used to evaluate the VI pathway. A separate groundwater data grouping was used to evaluate a construction/utility worker scenario, assuming construction/utility workers could be exposed to groundwater encountered at depths up to 10 feet bgs while replacing a culvert. A total of 22 groundwater samples were used to evaluate potential exposures in a trench for a construction/utility worker.

Table 5.4-4 lists the number of chemicals analyzed and detected in groundwater at Line 3:

Table 5.4-4. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Explosives	17	12
Metals, Total	23	17
PAHs	16	0
SVOCs	46	1

A description of the data groupings and samples included in the HHRA are provided in Tables 5.4-5 and 5.4-6, respectively. The analytical dataset used in the HHRA is included as Appendix A-5, Attachment 2. The groundwater sampling locations included in the HHRA are depicted in Figure 5.4-7.

Screening Results for Site-related Chemicals of Potential Concern and Naturally Occurring Chemicals

The approach and SLs used to select the COPCs (site-related COPCs or naturally occurring chemicals) are described in Section 4.3.1. The results of the COPC screening process for a future site worker, hypothetical resident, and construction/utility worker potentially exposed to groundwater are provided in Appendix A-5, Attachment 1 (Tables 2.1 through 2.3). The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are summarized in Tables 5.4-7 and 5.4-8.

Table 5.4-7. Summary of COPCs for Line 3—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (μg/L)	Maximum Detection (μg/L)
Groundwater Used for Tap Water				
Future Site Worker and Future Hypothetical Resident	2,4-DNT	4/42	0.7	1.2
	2,6-DNT	1/42	0.16	0.16
	2-amino-4,6-DNT	4/42	42.3	64
	4-amino-2,6-DNT	4/42	16.4	25
	HMX	6/42	0.2	160
	RDX	9/44	0.058	420
	Antimony	1/1	3	3
Groundwater to Indoor Air via Vapor Intrusion—no COPCs				
Shallow Groundwater in a Trench (<10 ft bgs)				
Future Construction/Utility Worker	2,4-DNT	4/20	0.7	1.2
	2,6-DNT	1/20	0.16	0.16
	2-amino-4,6-DNT	4/20	42.3	64
	4-amino-2,6-DNT	4/20	16.4	25
	HMX	5/20	2.5	160
	RDX	7/22	0.35	420
	Antimony	1/1	3	3

Table 5.4-8. Summary of COPCs for Line 3—Naturally Occurring
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water				
Future Site Worker and Future Hypothetical Resident	Arsenic	1/14	5.7	5.7
	Barium	14/14	52.9	412
	Cadmium	1/14	0.63	0.63
	Chromium	4/14	0.76	7.4
	Manganese	1/1	45.1	45.1
Groundwater to Indoor Air via Vapor Intrusion—no COPCs				
Shallow Groundwater in a Trench (<10 ft bgs)				
Future Construction/Utility Worker	Cadmium	1/12	0.63	0.63
	Chromium	3/12	0.76	1.1
	Manganese	1/1	45.1	45.1

5.4.6.3 Exposure Assessment

Line 3 is currently active for melt-pour operations for Stinger warheads and production of mine-clearing line charge, and there are buildings located within the Line 3 site boundary. Additionally, a new facility is planned for construction at Line 3. The site is closed to recreational activities; therefore, hunting is not permitted within the site boundary. There are no perennial surface water features present within the Line 3 boundary. As previously discussed, groundwater is not currently being used as a potable water source; however, the HHRA for Line 3 evaluated potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater. Therefore, ingestion and dermal contact exposures to COPCs in groundwater were evaluated for future site workers and hypothetical residents. Culverts are located at Line 3; therefore, potential ingestion and dermal contact exposures to shallow groundwater in a trench were evaluated for future construction/utility workers. As noted previously, risks and hazards for site workers and construction/utility workers are estimated only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk and hazard levels and COCs are identified for a residential scenario. Inhalation exposures to site groundwater are incomplete because no volatile chemicals were identified as COPCs in groundwater at Line 3. The potential exposure pathways quantified in the HHRA are included in Appendix A-5, Attachment 1 (Table 1) and in Figure 5.4-6. The following receptor scenarios were quantified in the HHRA for the Line 3:

- Future site worker.
  - Groundwater (tap water) COPCs—ingestion and dermal contact.
- Future construction/utility worker.
  - Shallow groundwater (trench, 0 to 10 feet bgs) COPCs—incidental ingestion and dermal contact.
- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion and dermal contact.

Risks and hazards for site workers and construction/utility workers were quantified in the HHRA because the estimated risks or hazards for a hypothetical residential scenario exceeded acceptable risk or hazard levels and COCs were identified for a residential scenario.

In accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b), groundwater EPCs are typically calculated based on the data collected in the core of a plume. One RDX plume is present at Line 3 (Figure 5.4-4). Two monitoring wells (JAW-54 and LS-MW1) are located within the core of the plume; 10 groundwater samples are available in the HHRA dataset for the RDX plume. If the MDC of a groundwater COPC was not in the subset of wells from the core of the RDX plume, the MDC of the COPC in the sitewide groundwater data set was used as the EPC.

For groundwater, where a sufficient number of samples and detected concentrations are available for COPCs, the UCLs on the mean are selected as the EPCs. The ProUCL output is provided in Appendix A-5, Attachment 3. For COPCs where fewer than eight samples or four detects were available, the MDCs were selected as the EPCs. For arsenic, barium, and chromium, the MDCs were located outside of the RDX plume (at sample station 16A) and were used for the EPCs. The groundwater EPCs used to estimate the daily intakes for groundwater exposures are provided in Appendix A-5, Attachment 1 (Tables 3.1 and 3.2).

The exposure factors used in the daily intake calculations for receptor scenarios are included in Appendix A-5, Attachment 1 (Tables 4.1 and 4.2). The primary references for the exposure factor values are the standard default exposure factors presented in the HHEM *Update of Standard Default Exposure Factors* (USEPA, 2014a).

5.4.6.4 Toxicity Assessment

The oral toxicity values (CSFs and RfDs) used in the HHRA were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as provided in Section 4.3.1. Noncancer toxicity values for the COPCs identified at Line 3 are provided in Appendix A-5, Attachment 1 (Table 5.1). Cancer toxicity values for the COPCs are provided in Appendix A-5, Attachment 1 (Table 6.1).

One COPC (chromium), which was evaluated as hexavalent chromium in the HHRA, was identified as acting with a MMOA in soil and two COPCs (hexavalent chromium and methylene chloride) were identified as acting with a MMOA in groundwater. The exposure parameters and equations used to calculate adjusted daily intakes for chromium are provided in Appendix A-5, Attachment 1 (Table 4 Supplement).

5.4.6.5 Risk Characterization

The risk characterization for Line 3 was completed using a four-step process, as discussed in Section 4.3.1. The results of each step are discussed below.

Step 1: Total Combined Risks and Hazards from Site-Related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculating receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. The estimated risks and hazards for a hypothetical residential scenario are summarized in Table 5.4-9.

Table 5.4-9. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	COPC/Chemical	Line 3		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.1 and 9.1	Groundwater (Tap water) Line 3	2,4-DNT	0.91	NA	0.01
			2,6-DNT	0.16	NA	0.02
			2-amino-4,6-DNT	47	NA	15
			4-amino-2,6-DNT	18	NA	6
			HMX	118	NA	0.07
			RDX	289	NA	2
			Antimony	3.0	NA	0.2
			Arsenic	5.7	NA	0.6
			Barium	412	NA	0.07
			Cadmium	0.63	NA	0.2
			Chromium	7.4	NA	0.1
			Manganese	45	NA	0.06
			Total HI (Groundwater):		**NA**	**24**
Hypothetical Resident (Child)	7.2 and 9.2	Groundwater (Tap water) Line 3	2,4-DNT	0.91	NA	0.02
			2,6-DNT	0.16	NA	0.03
			2-amino-4,6-DNT	47	NA	24
			4-amino-2,6-DNT	18	NA	9
			HMX	118	NA	0.1
			RDX	289	NA	4
			Antimony	3.0	NA	0.4
			Arsenic	5.7	NA	1
			Barium	412	NA	0.1
			Cadmium	0.63	NA	0.3
			Chromium	7.4	NA	0.2
			Manganese	45	NA	0.1
			Total HI (Groundwater):		**NA**	**39**
Hypothetical Resident (Adult/Child Aggregate)	7.3 and 9.3	Groundwater (Tap water) Line 3	2,4-DNT	0.91	4E-06	NA
			2,6-DNT	0.16	3E-06	NA
			2-Amino-4,6-DNT	47	NA	NA
			4-Amino-2,6-DNT	18	NA	NA

Table 5.4-9. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	COPC/Chemical	Line 3		
				EPC [b]	ELCR	HI
			HMX	118	NA	NA
			RDX	289	3E-04	NA
			Antimony	3.0	NA	NA
			Arsenic	5.7	1E-04	NA
			Barium	412	NA	NA
			Cadmium	0.63	NA	NA
			Chromium	7.4	2E-04	NA
			Manganese	45	NA	NA
			Total ELCR (Groundwater):		**6E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

NA = not applicable

RME = reasonable maximum exposure

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculation of receptor-specific ELCRs and HIs for naturally occurring chemicals. Five COPCs (arsenic, barium, cadmium, chromium, and manganese) were identified as naturally occurring chemicals in site groundwater at Line 3, as discussed in Section 5.4.4.2. The estimated risks and hazards for the naturally occurring chemicals in groundwater for a future hypothetical residential scenario are provided in Table 5.4-10. The naturally occurring chemicals are not used to identify the final COCs for Line 3 and are not discussed further in the HHRA after this step.

Table 5.4-10. Summary of Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	Chemical	Line 3		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.4 and 9.4	Groundwater (Tap water) Line 3	Arsenic	5.7	NA	0.6
			Barium	412	NA	0.07
			Cadmium	0.63	NA	0.2
			Chromium	7.4	NA	0.1
			Manganese	45	NA	0.06

Table 5.4-10. Summary of Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	Chemical	Line 3		
				EPC [b]	ELCR	HI
			Total HI (Groundwater):		**NA**	**1**
Hypothetical Resident (Child)	7.5 and 9.5	Groundwater (Tap water) Line 3	Arsenic	5.7	NA	1
			Barium	412	NA	0.1
			Cadmium	0.63	NA	0.3
			Chromium	7.4	NA	0.2
			Manganese	45	NA	0.1
			Total HI (Groundwater):		**NA**	**2**
Hypothetical Resident (Adult/Child Aggregate)	7.6 and 9.6	Groundwater (Tap water) Line 3	Arsenic	5.7	1E-04	NA
			Barium	412	NA	NA
			Cadmium	0.63	NA	NA
			Chromium	7.4	2E-04	NA
			Manganese	45	NA	NA
			Total ELCR (Groundwater):		**3E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

NA = not applicable

RME = reasonable maximum exposure

Step 3: Risk Characterization of Site-related COPCs

Step 3 consists of calculating receptor-specific ELCRs and HIs associated with site-related COPCs. One metal (antimony) and six explosives were identified as site-related COPCs for groundwater at Line 3. The estimated risks and hazards for site-related COPCs in groundwater for a hypothetical resident are provided in Table 5.4-11.

Table 5.4-11. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	COPC	Line 3		
				EPC [b]	ELCR	HI
Site Worker (Adult)	7.7 and 9.7	Groundwater (Tap water) Line 3	2,4-DNT	0.91	9E-07	0.004
			2,6-DNT	0.16	7E-07	0.005
			2-amino-4,6-DNT	47	NA	4
			4-amino-2,6-DNT	18	NA	2
			HMX	118	NA	0.02

Table 5.4-11. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	COPC	Line 3		
				EPC [b]	ELCR	HI
			RDX	289	7E-05	0.6
			Antimony	3.0	NA	0.06
			Total HI and ELCR (Groundwater):		**7E-05**	**6[c]**
Construction/Utility Worker (Adult)	7.8 and 9.8	Shallow Groundwater (Trench) Line 3	2,4-DNT	0.91	1E-10	0.0001
			2,6-DNT	0.16	1E-10	0.00004
			2-amino-4,6-DNT	47	NA	0.05
			4-amino-2,6-DNT	18	NA	0.02
			HMX	118	NA	0.0003
			RDX	289	1E-08	0.0005
			Antimony	3.0	NA	0.002
			Total HI and ELCR (Groundwater):		**1E-08**	**0.07**
Hypothetical Resident (Adult)	7.9 and 9.9	Groundwater (Tap water) Line 3	2,4-DNT	0.91	NA	0.01
			2,6-DNT	0.16	NA	0.02
			2-amino-4,6-DNT	47	NA	15
			4-amino-2,6-DNT	18	NA	6
			HMX	118	NA	0.07
			RDX	289	NA	2
			Antimony	3.0	NA	0.2
			Total HI (Groundwater):		**NA**	**23[d]**
Hypothetical Resident (Child)	7.10 and 9.10	Groundwater (Tap water) Line 3	2,4-DNT	0.91	NA	0.02
			2,6-DNT	0.16	NA	0.03
			2-amino-4,6-DNT	47	NA	24
			4-amino-2,6-DNT	18	NA	9
			HMX	118	NA	0.1
			RDX	289	NA	4
			Antimony	3.0	NA	0.4
			Total HI (Groundwater):		**NA**	**38[d]**
Hypothetical Resident (Adult/Child Aggregate)	7.11 and 9.11	Groundwater (Tap water) Line 3	2,4-DNT	0.91	4E-06	NA
			2,6-DNT	0.16	3E-06	NA
			2-amino-4,6-DNT	47	NA	NA

Table 5.4-11. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	COPC	Line 3		
				EPC [b]	ELCR	HI
			4-amino-2,6-DNT	18	NA	NA
			HMX	118	NA	NA
			RDX	289	3E-04	NA
			Antimony	3.0	NA	NA
				Total ELCR (Groundwater):	**3E-04[e]**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] The HI for hepatic (due to 2-Amino-4,6-DNT and 4-Amino-2,6-DNT) exceeds 1—Appendix A-7, Attachment 1 (see Tables 9.7).

[d] The HIs for hepatic (due to 2-Amino-4,6-DNT and 4-Amino-2,6-DNT) and nervous (due to RDX) exceed 1—Appendix A-7, Attachment 1 (see Tables 9.9 and 9.10).

[e] The ELCR exceeds 1×10^{-4} (due to 2,4-DNT, 2,6-DNT, and RDX)—Appendix A-1, Attachment 1 (see Table 9.11).

NA = not applicable

RME = reasonable maximum exposure

Step 4: Final COC Determination

For groundwater potable use by future hypothetical residents, the target organ–specific HIs exceeded USEPA's threshold of 1, and cumulative ELCR exceeded USEPA's acceptable risk range (1×10^{-6} to 1×10^{-4}) due to the COPCs indicated in Table 5.4-12:

Table 5.4-12. COPCs Exceeding USEPA Target Thresholds—Future Hypothetical Residents
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1×10^{-4}
2-Amino-4,6-DNT 4-Amino-2,6-DNT RDX	2,4-DNT 2,6-DNT RDX

These chemicals were identified as COCs in groundwater for future hypothetical residents. Therefore, potential exposures and risks and hazards were also estimated for future site workers and construction/utility workers (summarized in Table 5.4-11). For potable use of groundwater by future site workers, the target organ–specific HIs exceeded USEPA's threshold of 1, due to the COPCs indicated in Table 5.4-13:

Table 5.4-13. COPCs Exceeding USEPA Target Thresholds—Future Site Workers
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1×10^{-4}
2-Amino-4,6-DNT 4-Amino-2,6-DNT	None

For contact with shallow groundwater by future construction/utility workers, the cumulative ELCR and HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1, respectively, and no COCs were identified for this receptor. In summary, the following COCs were identified for groundwater, as presented in Appendix A-5, Attachment 1 tables (Table 5.4-14):

Table 5.4-14. Final COCs identified for Groundwater at Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

COC	Site Workers (Table 10.1)	Hypothetical Residents (Tables 10.2–10.4)
2,4-DNT	—	X
2,6-DNT	—	X
2-Amino-4,6-DNT	X	X
4-Amino-2,6-DNT	X	X
RDX	—	X

5.4.6.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. The general uncertainties associated with the HHRAs for the sites in this RI report are provided in Section 4.3.1. This section provides additional site-specific uncertainties associated with the HHRA for Line 3 that are not included in Section 4.3.1.

Hazard estimates for 2-amino-4,6-DNT and 4-amino-2,6-DNT could be over- or underestimated because screening RfDs were used in the risk calculations. As stated in the PPRTV documents for 2-amino-4,6-DNT and 4-amino-2,6-DNT (USEPA, 2022a, 2022b),

> It is inappropriate to derive a subchronic or chronic provisional RfD for [2-amino-4,6-dinitrotoluene or 4-amino-2,6-dinitrotoluene]. However, information is available which, although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors… Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of a supplemental screening toxicity value than for a value presented in the body of the assessment.

Chemicals that were 100 percent not detected in an exposure medium were not included in the COPC identification process; however, they were evaluated in a separate screening to determine whether elevated nondetected results were present in site media. The detailed analysis of the nondetected chemicals at Line 3 is provided in Appendix A-5, Attachment 4. In summary, one explosive (2-nitrotoluene), two metals (cobalt and thallium), seven PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene] and 12 SVOCs have DLs exceeding SLs at Line 3. Although the DLs for these nondetect chemicals are greater than the SLs, based on the rationale for DL exceedances and comparison to historically detected chemicals in groundwater at IAAAP, further consideration of nondetect chemicals does not appear warranted in the Line 3 HHRA.

5.4.6.7 Summary of HHRA

An HHRA was prepared for Line 3 to evaluate potential current and future health risks from exposure to chemicals in site groundwater. Line 3 is currently active, and there are number of buildings located within the Line 3 site boundary. The site is closed to recreational activities, and hunting is not permitted within the site boundary. There are no perennial surface water features present within the Line 3 boundary. There are no potential receptors or potentially complete exposure pathways identified for Line 3 under current site conditions.

The following potential future human receptors were identified in the HHRA for Line 3:

- Future Site Workers. Future site workers could contact groundwater based on potential future use as a drinking water source at Line 3 and could be exposed to indoor air (if impacted by volatile chemicals migrating from groundwater) in buildings.
- Future Construction/Utility Workers. Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 3.
- Future Hypothetical Residents. Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 3 and could be exposed to indoor air (if impacted by volatile chemicals migrating from groundwater) in buildings.

Potential exposures and risks and hazards to future site workers and construction/utility workers were estimated in the HHRA since estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk, and hazard levels and COCs were identified for a residential scenario.

The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are as follows:

- Groundwater (potable use):
  - Naturally occurring: arsenic, barium, cadmium, chromium, and manganese.
  - Site-related: antimony, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, and RDX.
- Groundwater (vapor intrusion): None.
- Groundwater (trench scenario):
  - Naturally occurring: cadmium, chromium, and manganese.
  - Site-related: antimony, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, HMX, and RDX.

The risk characterization for Line 3 was completed using a four-step process, as discussed in Section 4.3.1. Step 1 presents the total combined risks and hazards from site-related COPCs and naturally occurring chemicals, as summarized in Table 5.4-9. Step 2 presents the risks and hazards from naturally occurring chemicals, as summarized in Table 5.4-10. Step 3 presents the risks and hazards from site-related COPCs, as summarized in Table 5.4-11.

Unacceptable groundwater risks and hazards were identified for hypothetical residents, and 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX were identified as final COCs. Therefore, groundwater risks and hazards were also estimated for future site workers and construction/utility workers. 2-Amino-4,6-DNT and 4-amino-2,6-DNT were identified as COCs for future site workers, while no COCs were identified for future construction/utility workers.

In summary, the following COCs were identified for groundwater (Table 5.4-15):

Table 5.4-15. Final COCs for Line 3 Groundwater
Iowa Army Ammunition Plant, Middletown, Iowa

Future Site Worker	Future Construction/Utility Worker	Future Hypothetical Resident
2-amino-4,6-DNT 4-amino-2,6-DNT	None	2-amino-4,6-DNT 4-amino-2,6-DNT 2,4-DNT 2,6-DNT RDX

5.4.7 Ecological Risk Assessment

The ERA for groundwater at Line 3 is presented herein, beginning with Step 1 of the ERA process (to determine whether there are complete exposure pathways). Soil at Line 3 is already addressed under the remedy for OU-1. There are no perennial surface water features within the Line 3 boundary, so there are no complete exposure pathways for sediment or surface water. A summary of the Line 3 relationship with the Brush Creek watershed is discussed in the watershed ERA (CH2M, 2022) and included in Appendix I.

Groundwater is present onsite, but ecological receptors are not exposed directly to groundwater; however, groundwater is a transport medium, and contaminated groundwater has potential to migrate to and discharge to surface water bodies. Although there are ditches onsite for drainage purposes, these are not perennial waterbodies and do not provide suitable habitat for ecological receptors. Furthermore, as previously noted, there is not a connectivity between the ditch and groundwater. Given the lack of perennial surface water bodies on Line 3, the groundwater-to-surface-water exposure pathway is incomplete. Because there are no complete exposure pathways for ecological receptors for Line 3, no ecological adverse effects are likely. Therefore, no additional analyses from an ecological perspective are warranted.

5.4.8 Conclusions and Recommendations

An RI was conducted for Line 3 to refine the nature and extent of contamination in groundwater from historical activities and assess for potential unacceptable risk to human health and the environment. Soil at these sites were addressed under the remedial action for OU-1 and is not covered under this RI for OU-6. Analytical data available for groundwater at Line 3 include VOCs, SVOCs, explosives, and metals. Of these, only explosives were identified as site-related chemicals of interest based on historical site operations and a comparison of concentration data to site characterization PALs (listed in Appendix F) and BTVs. During the most recent groundwater monitoring well sampling events in 2006 and 2008, only 2,4-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX exceeded their site characterization PALs at one well, JAW-54. No explosives exceeded their respective site characterization PALs in the three DPT points installed and sampled at Line 3 during the 2018 RI sampling activities.

An HHRA and an ERA were conducted to quantify potential risks to human health and the environment from exposure to contaminants at the Line 3. The following conclusions were made based on the risk assessments:

- The HHRA identified potential unacceptable risks for the following media and receptors:
  - Future hypothetical resident: Potential unacceptable risks were identified for exposure to 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX in groundwater. These chemicals were identified as final groundwater COCs.
  - Future construction/utility workers: No potential unacceptable noncarcinogenic hazards or carcinogenic risks were identified for exposure to soil or groundwater.
  - Future site workers: Potential unacceptable risks associated with exposure to 2-amino-4,6-DNT and 4-amino-2,6-DNT were identified.
- The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 3.

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs (2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX) in groundwater at Line 3. It is recommended that an FS be conducted under OU-6 to evaluate remedial alternatives to address the unacceptable risks in groundwater at Line 3 (IAAP-

003G). When developing remedial alternatives, the FS should consider ongoing site operations and the reasonably foreseeable future land use for this area.

5.5 IAAP-004G_Line 3A Ammo LAP (Artillery) Groundwater (19105.1007)

This subsection summarizes RI activities at Line 3A. This report documents the RI for groundwater at Line 3A (IAAP-004G). Soil is addressed under the remedy for OU-1 (IAAP-004) (Leidos, 2018). There are no perennial surface water features within the Line 3A site boundary.

5.5.1 Background

5.5.1.1 Site Description

The Line 3A is an approximately 119-acre active site located in the southwestern quadrant of the IAAAP. The site contains approximately 64 buildings, 18 of which are related to explosives processing, but there are plans for the entire line to be demolished (Figure 5.5-1). The buildings are surrounded by isolated grassy areas and roads. A railroad track runs east–west along the northern portion of the site. Line 3A is located on an upland plateau that divides the Long Creek watershed to the north and east and the Skunk River watershed to the south (Figure 5.5-2).

5.5.1.2 Operational History

Line 3A, known as a “load line,” was established for loading large shells and bombs. Construction began in 1941, and operations began in 1942. Production was discontinued in 1945, but resumed in 1949 until updates were made in 1989. During this time, it functioned as an artillery loading, assembling, and packing (LAP) operation. Explosives were shipped into the plant, melted, and then poured into 155-mm artillery rounds. The finished munitions were assembled and either stored or shipped offsite. Line 3A has remained active since its updates in 1989, and current operations include LAP of artillery and other indirect fire munitions.

Chemicals used at Line 3A include TNT, RDX, HMX, ammonium nitrate, various solvents, and metals (Tetra Tech, 2006b). From 1969 to 1972, hexavalent chromium was used at Building 3A-05-1 (Shaw, 2005a). In addition, the melt buildings (Buildings 3A-05-1 and 3A-05-2) have historically generated the largest volume of wastewater due to the regular washdown (via steam cleaning) for explosive dust. Process water containing silver may have been discharged on the ground or into the ditches during the early years of X-ray processing at Building 3A-05-2 (Shaw, 2005a). Breakage of RDX bags during cleaning operations at Building 3A-05-2 may have caused approximately 3,700 pounds of material to be released into a ditch/drainpipe that led to Building 3A-100. Washdowns also occurred at the TNT screening buildings, and historical releases may also have occurred at Buildings 3A-140-1, 3A-140-2, and 3A-140-3 at their ammunition wash facilities (Figure 5.5-1).

NPDES discharges from Line 3A have occurred at two outfall locations: Outfall 34 (at Building 3A-70-1) and Outfall 35 (at Sump 21) (Figures 1-2 and 5.5-1). Both outfalls carried explosives-contaminated wastewater from LAP operations that was processed through carbon filter columns and subsequently discharged to a tributary of Skunk River for Outfall 34 and to an intermittent tributary that joins Long Creek approximately 1 mile from the site for Outfall 35. Both Outfall 34 and Outfall 35 are still included in the current (2020) NPDES permit (Permit 2900900) for IAAAP and active. Outfall 34 is permitted to discharge effluent with ammonia nitrogen, total iron, TNT, RDX, HMX, pH, 2,4-DNT, nitroguanidine, and nitrotriazolone, and Outfall 35 is permitted to discharge TNT, RDX, HMX, pH, 2,4-DNT, nitroguanidine, and nitrotriazolone. At both outfalls, samples are collected from the final effluent as grab or 24-hour composite samples. All analytes are sampled once every two weeks, except for flow, nitroguanidine, pH, temperature, and TNT, which are sampled once per week. Outfalls are permitted for explosives with a 30-day average of 0.75 mg/L and daily maximum discharge of 2.25 mg/L for RDX + HMX and with a 30-day average of 0.33 mg/L and daily maximum discharge of 0.91 mg/L for TNT (Figure 1-2).

5.5.1.3 Previous Investigations and Remedial Actions

Numerous investigations have been conducted at IAAAP since the 1980s. Table 5.5-1 summarizes the previous investigations and remedial actions conducted at Line 3A, including conclusions and recommendations. There are no perennial surface water features within the site boundaries. However, results from surface water and sediment samples collected from the intermittent features are discussed in Table 5.5-1 to support the CSM. Although soil at Line 3A has already been addressed under OU-1, previous investigations for soil are also presented in Table 5.5-1 to support the CSM.

This report summarizes the RI for groundwater at Line 3A (IAAP-004G). Previous investigations pertinent to the RI for groundwater are listed in Table 5.5-2; additional details on these investigations (including a more-detailed description of work completed as well as work not pertinent to this RI) are included in Table 5.5-1. Previous sample locations are shown on Figure 5.5-3.

Table 5.5-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 3A
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	A Preliminary Assessment was conducted for Line 3A to evaluate the potential for contamination and assess potential migration pathways and exposure potential if contamination were present. It was concluded that the area was a potential source of contamination based on historical site activities, and if contamination was present it would be migrating through groundwater and surface water to the southwest and northeast. It was recommended that groundwater, surface water, soil, and sediment sampling be conducted to determine the extent of contamination migration from the site.
Facility-wide Site Inspection (JAYCOR, 1992)	No groundwater samples were collected during the site inspection. It was recommended that Line 3A be further investigated in the Phase I RI to determine the extent of contamination at the site.
Follow-on RI (JAYCOR, 1996)	Eight shallow and deep overburden groundwater monitoring wells were installed during follow-on RI activities and sampled for explosives, metals, SVOCs, and VOCs. Explosives and metals were detected in groundwater at Line 3A.
Periodic Groundwater Monitoring (multiple reports)	Groundwater sampling was conducted at Line 3A between 1994 and 2008. The eight existing monitoring wells were sampled and analyzed for explosives, metals, SVOCs, and/or VOCs. Only RDX regularly exceeded its MCL in groundwater at Line 3A. Two additional explosives (2-amino-4,6-DNT and 4-amino-2,6-DNT) were detected at concentrations greater than their MCLs in well JAW-22 during the 2000, 2003, and 2006 sampling events.
Supplemental Groundwater RI Report (MWH, 2001)	One groundwater sample was collected from a boring in the vicinity of Building 3A-03-01 and analyzed for VOCs. No VOCs were detected in the groundwater sample; therefore, no additional investigation was recommended at this location.
Comprehensive Watersheds Evaluation and Supplemental Data Collection (Tetra Tech, 2006b)	The work plan concluded that the southern extent of the groundwater RDX plumes had not been established. Additional groundwater samples were recommended to verify that the plumes had not expanded or migrated.
OU-6 SRI (Tetra Tech, 2012a)	A groundwater sample was collected from one temporary monitoring well, L3A-TTTW-001 in 2007 to delineate downgradient contamination downgradient of JAW-22. Groundwater samples were analyzed for explosives. The report concluded that the eastern RDX plume at Line 3A was considered horizontally defined by L3A-TTTW-001, and although the western plume was not delineated by a sampling point, it was considered horizontally delineated based on the similar concentrations and the extent of the eastern plume.

As part of the previous investigations under OU-1, TNT, 2,4-DNT, RDX, and lead were identified as COCs, and copper was identified as a chemical of ecological concern for soil (Tetra Tech, 2009b). To address risks and hazards associated with these COCs, soil removal actions were completed and LUCs have been implemented, as summarized in Table 5.5-1. A total of 1,436 cubic yards of contaminated soil was removed from 17 excavations at Line 3A (Figure 5.5-1). Based on confirmation sampling, no soil concentrations above OU-1 RGs remains at Line 3A except in two areas where RDX-contaminated soil was left in place due to accessibility constraints: one area north of Building 3A-10-5 and one area north of Building 3A-08-1. No further excavation was deemed possible at these two areas. Contaminated soil along the south wall of excavation L3A-03, north of Building 3A-10-5, could not be removed without undermining the foundation of the vacuum house, and the contamination will be left in place until the vacuum house is removed. Contaminated soil along the south wall of excavation L3A-09, north of Building 3A-08-1, could not be removed without undermining the foundation of a loading platform, and the contamination will be left in place until the loading platform is removed (USACE-Baltimore, 2016). The maximum concentration of RDX left in place at Line 3A was 44.8 mg/kg (north of Building 3A-10-5), above the soil RG, 1.3 mg/kg (Tetra Tech, 2009b).

Additional soil investigation was conducted at Line 3A in 2022 to determine if contaminated soil exists beneath recently demolished buildings and delineate the contamination in vadose zone soil that exceeds OU-1 RGs (TAC, 2022). The IAAAP is currently undergoing a modernization effort involving the demolition of numerous buildings throughout the Plant. The analytical results will be used to support future remedial design for soil contaminants under OU-1, and would be considered when developing the FS for OU-6, if a new soil source to groundwater was identified.

5.5.2 2018–2020 Remedial Investigation Activities

- Additional field work was conducted at Line 3A to resolve data gaps needed to complete the RI for groundwater. As documented in the final Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant (Packet 2) (CH2M, 2018a), additional investigation of groundwater was warranted to adequately refine the horizontal and vertical extent of two RDX plumes present at Line 3A, a western plume near Building 3A-05-02 and an eastern plume near Buildings 3A-05-01 and 3A-70-1. Six colocated overburden well pairs, consisting of one shallow well at the groundwater table and one deeper well at the overburden/bedrock interface, plus one additional deep overburden well, were installed to meet the data objectives as follows: The western RDX plume at Line 3A contained historical exceedances in shallow overburden wells JAW-15 and JAW-17 (both screened 5 to 30 feet bgs) and in deep overburden well JAW-18 (screened 36 to 51 feet bgs) and is delineated to the southeast at JAW-16. However, the extent of this RDX plume was uncertain to the north, south, and west. To address this data gap, four monitoring well pairs (L3A-MW1A/B through L3A-MW4A/B) were proposed to delineate the western RDX plume and evaluate current conditions (Figure 5.5-3).
- The eastern RDX plume at Line 3A contained concentrations of RDX just greater than the Health Advisory Level (HAL) and was concentrated around well pair JAW-21 (screened across the water table) and JAW-20 (screened in the deep overburden). To address data gaps around this well pair, one additional deep overburden well (L3A-MW7) and two overburden well pairs (L3A-MW5A/B and L3A-MW6A/B) were proposed to horizontally and vertically delineate RDX (Figure 5.5-2). Groundwater samples were also collected to evaluate the current plume conditions. Fieldwork completed at Line 3A was conducted in accordance with the UFP-QAPP (CH2M, 2018a).

5.5.2.1 2018 Field Activities

From July 21 through 23, 2018, eleven new monitoring wells were installed at Line 3A. Three overburden monitoring well pairs (L3A-MW1A/B, L3A-MW3A/B, and L3A-MW4A/B) were installed around Building 3A-05-2 to delineate the western RDX plume (Figure 5.5-3). Two monitoring well pairs

(L3A-MW5A/B and L3A-MW6A/B) were installed north and east of JAW-20/JAW-21, and one deep overburden monitoring well (L3A-MW7) was installed adjacent to JAW-22 to delineate the eastern RDX plume. One well pair (L3A-MW2A/2B), proposed to refine RDX concentrations in the western plume between JAW-15 and JAW-17/JAW-18, could not be installed due to dense utilities and the lack of an alternative location.

New monitoring wells were drilled via rotosonic drilling techniques with a MiniSonic drill rig (deep overburden monitoring wells) and with a Geoprobe HSA drill rig (shallow overburden monitoring wells) in accordance with procedures outlined in Section 3.2.3. For monitoring well pairs, only the deep overburden monitoring well borings were logged for lithology. Deep overburden monitoring well locations were drilled to observed bedrock or to refusal. L3A-MW1B was drilled to 56 feet bgs, L3A-MW3B was drilled to 50 feet bgs, L3A-MW4B was drilled to 55 feet bgs, L3A-MW5B was drilled to 46 feet bgs, L3A-MW6B was drilled to 63.5 feet bgs, and L3A-MW7 was drilled to 63 feet bgs. Boring logs are provided in Appendix C.

In accordance with the UFP-QAPP, shallow overburden monitoring wells were screened across the perceived water table, and deep overburden monitoring wells were screened just above bedrock. Well construction details are provided in Table 5.5-3. Each monitoring well was completed with a 2-inch-nominal-diameter Schedule 40 PVC screen and riser and 0.5-foot Schedule 40 PVC end cap. All monitoring wells were screened with a machine-slotted, 0.010-inch, 10-foot screen, except at L3A-MW1A, where a 20-foot screen was installed, and at L3A-MW6A, where a 15-foot screen was installed to screen across observed sand lenses. Each monitoring well was constructed with a certified-clean silica sand filter pack from the base of the borehole to 2 to 3 feet above the top of the screen. A 3- to 4.5-foot-thick bentonite layer was placed above the filter pack sand and hydrated. The well was grouted to the surface, and a steel stick-up well protector was installed and surrounded by three bollards. Well completion diagrams are included in Appendix C.

In August 2018, newly installed monitoring wells were developed in accordance with procedures in Section 3.2.4. L3A-MW1A, L3A-MW3A, L3A-MW4A, L3A-MW5A, and L3A-MW6A were developed on August 4, 2018; L3A-MW4B and L3A-MW5B were developed on August 15, 2018; and L3A-MW1B, L3A-MW3B, L3A-MW6B, and L3A-MW7 were developed on August 19, 2018. Monitoring wells were developed through a series of surging and pumping. During the development process, specified in Section 3.2.4, all monitoring wells purged dry at least once due to limited permeability, except for L3A-MW1B. Monitoring well L3A-MW1B did not purge dry when following the development procedures. All Line 3A monitoring wells were considered developed due to the slow recharge. Well development logs are provided in Appendix C.

All newly installed monitoring wells (L3A-MW1A through L3A-MW7) were sampled via low-flow purging and sampling techniques, or by purging a minimum of three well volumes at locations where low-flow was not feasible (L3A-MW5B), between August 17 and 29, 2018. Additionally, eight existing monitoring wells (JAW-15 through JAW-22) were sampled via low-flow purging and sampling techniques on August 16 and 17, 2018. Groundwater samples were collected for explosives by Method SW8330B. Purge logs are included in Appendix C. Data were managed and validated as discussed in Section 3.3. Laboratory reports are provided in Appendix B.

All IDW generated during activities (soil and purge water) was disposed of in accordance with management activities discussed in Section 3.2.9. Waste management documentation is provided in Appendix D.

The 11 new monitoring wells (L3A-MW1A through L3A-MW7) were surveyed by Bruner, Cooper, and Zuck, Inc., licensed Iowa surveyors, on September 20, 2018, in accordance with procedures in Section 3.2.7. Existing monitoring well JAW-19 was resurveyed by Bruner, Cooper, and Zuck, Inc. on December 16, 2019, due to the lack of top-of-casing elevation data. Survey information is included in Appendix E.

5.5.2.2 Deviations and Follow-on Field Activities (2019–2020)

The final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 1)* (CH2M, 2017b) proposed the installation of 13 new monitoring wells (six well pairs and one deep overburden monitoring well) to delineate the western and eastern RDX plumes at Line 3A. All proposed monitoring wells were installed except for one monitoring well pair (L3A-MW2A/B) that could not be installed due to dense utilities and the lack of a suitable alternative location. However, data from the 11 new monitoring wells and eight existing monitoring wells (JAW-15 through JAW-22) did not adequately address the data quality objectives in the UFP-QAPP. Therefore, five additional temporary wells were installed and sampled for explosives in 2019. These wells provided sufficient data, so there was no impact to the study.

Four shallow overburden temporary wells (L3A-TW19-01, L3A-TW19-02, L3A-TW19-03, and L3A-TW19-04A) and one deep overburden temporary well (L3A-TW19-04B) were installed April 26–28, 2019. One temporary well (L3A-TW19-01) was installed south/downgradient of JAW-22/L3A-MW7; two temporary wells (L3A-TW19-02 and L3A-TW19-03) were installed northeast/downgradient of L3A-MW5A/B and L3A-MW4A/B, respectively; and a temporary well pair (L3A-TW19-04A/04B) was installed northwest/downgradient of JAW-17/JAW-18 to further refine the extent of contamination in groundwater at Line 3A (Figure 5.5-3). Borings for L3A-TW19-01 through L3A-TW19-03 were drilled to 20 feet bgs. The boring for L3A-TW19-04B was drilled to 54 feet bgs to observed bedrock, and associated shallow overburden L3A-TW19-04A was drilled to 25 feet bgs; only the deep boring was logged for lithology. Boring logs are provided in Appendix C.

In accordance with the UFP-QAPP, temporary wells were screened across the observed water table from 10 to 20 feet bgs at L3A-TW19-01 through L3A-TW19-03, 15 to 25 feet bgs at L3A-TW19-04A, and 43 to 53 feet bgs at L3AP-TW19-01. Temporary monitoring wells were constructed with a certified-clean 20/40 silica sand filter pack from the base of the borehole to 2 feet above the top of the screen. A bentonite layer was placed above the filter pack sand and hydrated. Temporary monitoring wells did not require additional well completion. Temporary well construction details are provided in Table 5.5-3. Temporary wells were surveyed with a hand-held GPS unit.

The temporary monitoring wells L3A-TW19-01, L3A-TW19-02, L3A-TW19-03, and L3A-TW19-04B were sampled via low-flow sampling techniques on April 27–29, 2019. The collection of a sample was attempted at temporary well L3A-TW19-04A on April 28, 2019; however, the well was dry (less than 0.14 foot of water was measured). Temporary well L3A-TW19-04A was left in place to allow for groundwater to recharge into the well and a sample was collected on July 11, 2019. All temporary wells were sampled for explosives by Method SW8330B. Purge logs are included in Appendix C. Data were managed and validated as discussed in Section 3.3. Laboratory reports are provided in Appendix B.

Following sampling activities, the temporary monitoring wells were abandoned in accordance with Section 3. All IDW generated during activities (soil and purge water) was disposed of in accordance with the management activities discussed in Section 3.2.8.

5.5.3 Environmental Setting

The topography at Line 3A is generally flat and on top of a ridge that divides the Long Creek watershed to the north and the Skunk River watershed to the south. The surrounding ground slopes to the north, south, and west. Surface drainage is through ditches and intermittent streams (Figure 5.5-3). Ditches in the south/southwest portion of the site discharge to three intermittent streams that ultimately join Skunk River approximately 1 mile south of Line 3A. Ditches in the north/northeast portion of the site discharge to three intermittent streams that ultimately join Long Creek approximately 2,000 feet north/northeast of the site.

A cross section depicting geology at Line 3A is provided in Figure 5.5-4. The subsurface overburden at the Line 3A is characterized by till consisting of a homogeneous mix of clay, lean clay, sandy clay, and silt with occasional discontinuous sand lenses encountered at depths greater than 30 feet bgs. The thickness of the Kellerville Till at Line 3A, observed during the 2018–2019 RI, is approximately 44.5 to 61 feet bgs and is underlain by bedrock. The uppermost bedrock unit in the Line 3A area is composed of shale and limestone of the upper Warsaw Formation.

During the 2018 RI gauging event, groundwater at Line 3A was encountered between 10 and 15 feet bgs within the shallow overburden monitoring wells and between 13 and 51 feet bgs in deep overburden monitoring wells (Table 5.5-4 and Figure 5.5-3). Overburden groundwater at Line 3A has historically been encountered at depths ranging from approximately 1 to 12 feet bgs and has reflected generally unconfined conditions. A downward vertical gradient is observed, based on all well pairs at Line 3A. All monitoring well pairs are screened in the overburden.

Line 3A falls along a potentiometric divide; therefore, overburden groundwater flows south-southwest toward the Skunk River in the southern half of the site and north-northeast toward Long Creek in the northern half of the site (Figure 5.5-2). Horizontal hydraulic gradients range from 0.003 to 0.025 foot per foot. Based on historical sitewide potentiometric surface maps (Figure 2-3), bedrock groundwater flow direction is similar to overburden groundwater flow. No hydraulic conductivity (*K*) values have been calculated from slug test data for the wells at Line 3A. Values in this area are considered to be consistent with *K* values calculated in other wells screened in till and till combinations (an average of 0.64 foot/day), as discussed in Section 2.6.

5.5.4 Nature and Extent of Contamination

This subsection describes the nature and extent of groundwater contamination at Line 3A. Soil has been addressed under OU-1; however, soil is discussed briefly to inform the CSM for potential groundwater contaminants. There are no perennial surface water features associated with this site.

The primary source of contamination at the Line 3A is attributed to the LAP operations, including the use of TNT, RDX, MHX, ammonium nitrate, various solvents from paint-stripping and renovation operations, and metals, and from explosives-contaminated wastewater from sump overflows or spills. The sumps at Line 3A are no longer in use for processing wastewater; rather, wastewater is processed in a closed-loop system and is treated before being discharged from NPDES Outfalls 34 and 35. The locations of Sumps 20 and 21 coincide with the 2006 soil excavations conducted at Buildings 3A-50-1 and 3A-50-2. The site remains an active LAP line.

5.5.4.1 Groundwater

Groundwater samples have been collected at the Line 3A as part of several investigations between 1993 and 2019. Nineteen monitoring wells are present at Line 3A. Ten are screened within the shallow overburden to depths ranging from 5 to 30 feet bgs, and nine are screened within the deep overburden to depths ranging from 35 to 62.5 feet bgs (Figure 5.5-3). Historical groundwater samples were analyzed for explosives, VOCs, SVOCs, PAHs, PCBs, pesticides, and metals. Detected chemicals are discussed in further detail below. No SVOCs, PAHs, pesticides, or PCBs were detected in historical groundwater samples. Based on historical site operations and COCs identified in soil, explosives and metals are considered chemicals of interest in groundwater at Line 3A.

During the current RI, groundwater samples were collected from all 19 new and existing monitoring wells (L3A-MW1A/B, and L3A-MW3A through L3A-MW7) and from five temporary wells (L3A-TW19-01 through L3A-TW19-04B) (Figure 5.5-3) and analyzed for explosives. Although metals are considered chemicals of interest, they were not analyzed for since no data gaps were identified for them in the final UFP-QAPP (CH2M, 2018a). Table 5.5-5 presents the concentrations of chemicals detected in groundwater samples during recent sampling events (2000–2019). Statistical summary tables of the analytical results used in the HHRA are included in Section 5.5.6. Summary tables of all the analytical results, including nondetects, from the recent RI activities (2018 to 2019) are provided in Appendix G. Summary tables of all the historical analytical results, including nondetects, from Line 3A are provided in Appendix H.

VOCs

Two VOCs (TCE and chloroform) have been detected in groundwater at Line 3A (Appendix H). However, neither of these VOCs exceeded their site characterization PALs. The dissolved gas methane has also been detected in groundwater.

Explosives

Thirteen explosives were detected in groundwater at Line 3A between 2000 and 2019 (Table 5.5-5). Over this period, three explosives, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX, were detected in groundwater at concentrations greater than their site characterization PALs. However, during the current RI (2018 through 2020), only RDX was detected at a concentration greater than its site characterization PAL. The decrease of 2-amino-4,6-DNT and 4-amino-2,6-DNT concentrations less than their PALs may be the result of natural attenuation and/or the soil removal actions that were conducted in 2006.

RDX is present as one large plume at Line 3A (Figure 5.5-5). It was detected at a concentration greater than its PAL at eight locations: six shallow overburden wells (JAW-15, JAW-17, JAW-21, JAW-22, L3A-MW4A, and L3A-MW5A) and two deep overburden locations (JAW-18 and JAW-20). Note that while JAW-20 is listed as a shallow overburden well (screened 5 to 20 feet) and JAW-21 is listed as a deep overburden well (screened 43 to 58 feet) according to historical well installation information, measurements from 2018 identified JAW-20 to be a deep overburden well (depth to bottom 57.8 feet below top of casing) and JAW-21 to be a shallow overburden well (depth to bottom 23.15 feet below top of casing). Therefore, this well pair is discussed in accordance with 2018 measurements, which are also consistent with interpretations from the groundwater monitoring program (Harza, 2001) and the OU-6 data gaps investigation work plan (Tetra Tech, 2016), indicating these wells have been mislabeled and have been consistently sampled in accordance with the measurements collected in 2018. The maximum concentration was detected at JAW-17 (160 µg/L) in 2018. JAW-17, screened from 5 to 15 feet bgs, is located northwest and downgradient of melt Building 3A-05-2 (Figure 5.5-5). RDX concentrations detected at JAW-18 were 100 J µg/L in 2018, screened 36 to 51 feet bgs, adjacent to JAW-17. Concentrations at well pair JAW-17/JAW-18 have increased from less than 20 µg/L in 2008 to concentrations greater than 100 µg/L in 2018. RDX concentrations at temporary well pair L3A-TW19-04A and L3A-TW19-04B, screened 15 to 25 feet bgs and 43 to 53 feet bgs, respectively, were nondetect in 2019. Therefore, concentrations are considered delineated to the northwest and downgradient of JAW-17/JAW-18.

RDX concentrations were also nondetect at L3A-MW1A, L3A-MW1B, L3A-MW3A, L3A-MW3B, L3A-MW7, L3A-TW19-01, L3A-MW6A, L3A-MW6B, L3A-TW19-02, and L3A-TW19-03, providing downgradient and vertical delineation for the RDX plume at Line 3A (Figure 5.5-5). L3A-MW4B and L3A-MW5B, deep overburden wells along the northern edge of the RDX plume, contained RDX concentrations of 0.3 µg/L and 0.13 J µg/L, less than the PAL, providing additional vertical delineation along the northeast portion of the RDX plume.

Monitoring wells JAW-18 and JAW-20 were installed to the top of the bedrock. Therefore, the vertical extent of the RDX plume within the overburden aquifer is understood. In addition, RDX concentrations in downgradient monitoring well L3A-MW7, which extends deeper than JAW-18 and JAW-20, were below the PAL in 2018-2019. Although bedrock wells have not been installed, or proposed, at Line 3A, they have been installed at other IAAAP sites (such as in the Explosives Disposal Area and the Demolition Area). Groundwater data from these areas show that while RDX may be found in shallow bedrock, there are no exceedances in deeper bedrock; limited fractures and moisture content were observed in the bedrock cores collected during the RI from these areas. In addition, the 1996 RI noted the presence of few vertical fractures at Line 3A (JAYCOR, 1996). Therefore, even if the RDX plume extends into the bedrock, its vertical extent should be limited.

Metals

Eight metals (barium, cadmium, calcium, chromium, lead, magnesium, selenium, and sodium) were detected in groundwater at Line 3A (Table 5.5-5) between 2000 and 2003. No metals were detected in exceedance of their respective PALs and BTVs in groundwater at Line 3A. Six metals (cadmium, calcium, chromium, lead, selenium, and sodium) were detected at concentrations less than their BTVs and therefore are considered consistent with background and naturally occurring. Although barium was detected at a concentration greater than its BTV, it is also considered to be naturally occurring in groundwater at Line 3A. Barium only slightly exceeded its BTV of 430 µg/L in one well, JAW-16 (434 µg/L the last time it was sampled, in 2003). Concentrations of barium were less than its BTV in this well in the prior three sampling events (in 2000, 2001, and 2003). Of note is explosives, which are the primary contaminants in this area, were not detected in this well, indicating that this well has not been impacted by a site release.

5.5.5 Fate and Transport

This section discusses the fate and transport of site-related chemicals of interest at Line 3A. This includes chemicals that were detected at concentrations greater than their site characterization PAL and BTV (if available) during the last sampling event in which those chemicals were analyzed. In groundwater, only one site-related chemical of interest was identified, RDX. Fate and transport characteristics for this chemical is described in Section 4.2.

Line 3A is relatively flat, active line that sits on top of a ridge that divides the Long Creek watershed to the north and the Skunk River watershed to the south. Buildings at this line are surrounded by isolated grassy areas and roads. Surface drainage is intermittent and through ditches that ultimately join the Skunk River approximately 1 mile south of Line 3A and Long Creek approximately 2,000 feet north-northeast of the site.

Contaminants have entered groundwater at Line 3A due to the historical LAP operations and from explosives-contaminated wastewater from sump overflows or spills and the subsequent leaching of chemicals through unsaturated zone soil. The sumps, formerly identified as possible sources of contamination at Line 3A, are no longer in use for processing wastewater, and the locations of Sumps 20 and 21 coincide with the 2006 soil excavations conducted at Buildings 3A-50-1 and 3A-50-2. Confirmation sampling indicated RDX-contaminated soil at concentrations greater than OU-1 RGs was left in place in two areas due to inaccessibility: one south of the railroad tracks near Building 3A-08-1 and one north of the vacuum house, north of Building 3A-10-5 (Tetra Tech, 2009b). The groundwater table at Line 3A is relatively shallow, and groundwater in the shallow portion of the overburden aquifer was encountered between 10 and 15 feet bgs during the current RI.

Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Because Line 3A is located within two watersheds, a groundwater divide is present, and groundwater flows south-southwest toward the Skunk River in the southern half of the site and north-northeast toward Long Creek in the northern half of the site. Given that the overburden aquifer is composed predominantly of clays and that the hydraulic gradient is assumed to be low, the groundwater flow velocity should be very slow. However, the velocity may be faster within the sand seams present with the aquifer, which were observed at depths greater than 30 feet bgs.

Natural attenuation mechanisms that are potentially active at Line 3A were evaluated. Natural attenuation includes various physical, chemical, or biological processes that under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. A weight-of-evidence approach was used for this evaluation.

- The primary line of evidence that attenuation is occurring at a site is reduction over time in contaminant concentrations or mass or both. Previously, RDX was thought to be present in two distinct plumes; however, based on results from the 2018 sampling event, only one RDX plume was identified.
  - Historically, the greatest concentrations were observed at JAW-22, with RDX concentrations alternating between approximately 250 µg/L and nondetect between 1999 and 2006. JAW-22 is located southeast near Building 3A-70-1 (Figure 5.5-5). Soil remedial actions in this area reportedly removed all contaminated soil. In 2018, RDX concentrations at JAW-22 (75 µg/L) were less than these historical highs, but they have increased since this location was last sampled, in 2008 (Table 5.5-5). Figure 5.5-6 presents the trend graph for JAW-22 between 1993 and 2018.
  - In 2018, the maximum concentration of RDX (160 µg/L) was detected at shallow overburden monitoring well JAW-17, located in the northwest portion of the RDX plume, north and downgradient of Building 3A-10-5 (Figure 5.5-5). Building 3A-10-5 was one of the two locations where soil removal actions did not remove all RDX-contaminated soil. Prior to 2008, RDX concentrations at this location were less than 20 µg/L, demonstrating a large increase in concentrations during the recent sampling event. Figure 5.5-6 presents the trend graphs for JAW-17 and JAW-18 between 1993 and 2018.
  - RDX concentrations have increased at seven existing well locations between 2008 and 2018. Therefore, there may be a continuing source(s) at this site.
- Anaerobic daughter products of RDX (TNX and DNX) were detected in groundwater from several monitoring wells at Line 3A, including the recent 2018 monitoring event. This provides evidence that anaerobic biodegradation of RDX is occurring in the Line 3A area.
- Water quality parameters can be used to evaluate whether the geochemical conditions are conducive to biodegradation. During the current RI, groundwater at Line 3A was observed to be under aerobic and generally oxidizing conditions. DO ranged from 1.12 to 10.13 mg/L, and ORP ranged from +44.1 to +244.5 mV in the permanent, shallow overburden wells onsite. Reduction-oxidation (redox) conditions are more variable in deep groundwater. The DO ranged from 0.18 to 18.57 mg/L, and ORP ranged from -43.3 to +269.1 mV in the permanent, deep overburden wells onsite (Table 5.5-6). However, the high DO reading recorded at deep overburden well JAW-16 (18.57 mg/L) is considered to be inaccurate, given that the value exceeds typical DO saturation limits. In all other deep overburden wells, DO readings were generally recorded at concentrations less than 8 mg/L. pH values were relatively neutral (between 6 and 8), which is favorable for biological activity. Under these geochemical conditions, anerobic biodegradation of explosives, particularly RDX, would be less favorable. Nevertheless, the presence of anerobic RDX daughter products (DNX and TNX) indicates that anaerobic biodegradation has occurred.
- Physical natural attenuation processes are also likely helping to stabilize the plume; however, some migration may have occurred in the northwest and southeast directions. While RDX has a relatively low sorption potential, it should be retarded somewhat as it sorbs to the clay geology in this area. The limited RDX contamination observed below 30 feet bgs confirms vertical migration is limited at Line 3A. However, the explosives have limited volatility (Table 4.2-1), and therefore RDX is unlikely to volatilize into soil gas at the water table interface.

5.5.6 Human Health Risk Assessment

An HHRA was prepared for Line 3A (IAAP-004G) to evaluate potential current and future health risks and hazards from exposure to chemicals in site groundwater. Soil media is not included in the HHRA, as it not a component of this RI; the soil RI was conducted under OU-1. As discussed in Section 5.5.1.3, contaminants in soil were removed to meet their OU-1 RGs under multiple removal actions, with the exception of RDX at two areas. Surface water and sediment media are not included in the HHRA as perennial surface water features are not present at Line 3A. The HHRA was conducted in accordance with the final UFP-QAPP (CH2M, 2017b), with the exception of some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final UFP-QAPP. The approach and method used to conduct the HHRA are provided in Section 4.3.1. This section presents the CEM for Line 3A and provides the results of the four-step evaluation process composed of:

- Data evaluation.
- Exposure assessment.
- Toxicity assessment.
- Risk characterization.

The results of the HHRA are used to determine if further action is warranted for groundwater at Line 3A.

5.5.6.1 Conceptual Exposure Model

A description of Line 3A, its operational history, previous investigations, and remedial actions are provided in Sections 5.5.1 and 5.5.2. The soil at Line 3A is addressed under the remedy for OU-1 (IAAAP Site IAAP-004) (Leidos, 2018) and was not reevaluated in this HHRA.

Line 3A is an approximately 119-acre site containing an active munitions LAP line. The site contains approximately 64 buildings, 18 of which are related to explosives processing. The buildings are surrounded by isolated grassy areas and roads. There are no perennial surface water features within the Line 3A site boundary. The site is closed to recreational activities; therefore, hunting is not permitted within the site boundary. There are culverts located at Line 3A; therefore, groundwater exposure by construction/utility workers is a potentially complete pathway.

Groundwater is not currently being used as a potable water source and there are no plans to use groundwater for potable purposes in the future; however, based on applicable CERCLA policy and guidance, groundwater at Line 3A is classified as Class IIB, a potential source of drinking water (USEPA, 1989). Therefore, the HHRA for Line 3A evaluates potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater.

The following potential future human receptors were identified in the HHRA for Line 3A:

- **Current Site Workers.** Current site workers could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in active buildings at Line 3A.
- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 3A and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 3A.

- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 3A and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in buildings.

As discussed in Section 4.3.1, potential exposures and risks and hazards to future site workers and construction/utility workers are estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels and COCs are identified for a residential scenario. The human health CEM presenting potential exposure media, exposure points, receptors (current and future), and exposure routes is provided in Appendix A-6, Attachment 1 (Table 1), and depicted graphically in Figure 5.5-7.

5.5.6.2 Data Evaluation

Data Used in the HHRA

The analytical data used in the HHRA consisted of groundwater samples collected at Line 3A. Historical groundwater samples collected from 2000, 2003–2004, and 2006–2007 and recent samples collected in 2018 and 2019 were used in the HHRA for Line 3A. Historical groundwater samples were analyzed for explosives, metals, SVOCs, and VOCs. However, neither SVOCs nor VOCs were detected in groundwater samples from this time period. As stated in the UFP-QAPP (CH2M, 2017a), "Older data (i.e., data collected prior to 2012) may be used in the human health risk assessments if they are still representative of the site (i.e., groundwater flow is slow), chemicals have properties where there would not be a significant reduction in concentrations over time (e.g., metals), or data are conservative for site conditions." Potential soil sources to groundwater at Line 3A have been remediated, as described in Section 5.5.1.3. Due to a lack of continuing sources, historical concentrations in groundwater are expected to have remained stable or even decreased due to natural attenuation processes. Therefore, the assumptions in the final UFP-QAPP still hold. Samples collected prior to 2012 are considered representative of, or more conservative than, current conditions at Line 3A.

Fifty-four groundwater samples were used to evaluate potential exposures for a potable use and vapor intrusion scenarios. Twenty-six groundwater samples were used to evaluate shallow groundwater in a culvert. From the 2003 and 2004 samples, only metals were evaluated in the HHRA because more recent data were available for explosives and SVOCs; from the 2000, 2006, and 2007 samples, only SVOCs and VOCs were evaluated in the HHRA because more recent data were available for metals and explosives. Only explosives were analyzed in the 2018 and 2019 samples and were used in the HHRA. The following lists the number of chemicals analyzed and detected in groundwater at Line 3A (Table 5.5-7):

Table 5.5-7. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Explosives	17	11
Metals, Total	8	3
SVOCs	1	0
VOCs	44	0

Descriptions of the data groupings and samples included in the HHRA are provided in Tables 5.5-8 and 5.5-9, respectively. The analytical dataset used in the HHRA is included in Appendix A-6, Attachment 2. The groundwater sampling locations included in the HHRA are depicted in Figure 5.5-9.

Screening Results for Site-related Chemicals of Potential Concern and Naturally Occurring Chemicals

The approach and SLs used to select the COPCs (site-related COPCs or naturally occurring chemicals) are described in Section 4.3.1. The results of the COPC screening process for a future hypothetical resident potentially exposed to groundwater are provided in Appendix A-6, Attachment 1 (Tables 2.1 and 2.2). The tap water RSL for hexavalent chromium was used in the COPC screening process for total chromium because the groundwater samples collected at Line 3A were not analyzed for hexavalent chromium. As summarized below, three explosives and two metals were identified as COPCs (site-related COPCs or naturally occurring chemicals) in groundwater for a potable use scenario. No chemicals were identified as COPCs in groundwater for vapor intrusion. The COPCs (site-related COPCs or naturally occurring chemicals) are addressed further in the HHRA, and potential exposures and risks and hazards were estimated for each COPC (site-related COPC or naturally occurring chemical) (Tables 5.5-10 and 5.5-11).

Table 5.5-10. Summary of COPCs for Line 3A—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water				
Future Hypothetical Resident	2-Amino-4,6-DNT	1/24	0.97	0.97
	4-Amino-2,6-DNT	3/24	0.32	1.1
	RDX	11/24	0.084	160
	Barium	7/7	86.4	434
Groundwater to Indoor Air via Vapor Intrusion—No COPCs				

Table 5.5-11. Summary of COPCs for Line 3A—Naturally Occurring
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water				
Future Hypothetical Resident	Chromium	3/7	0.85	2.3
Groundwater to Indoor Air via Vapor Intrusion—No COPCs				

5.5.6.3 Exposure Assessment

Line 3A is an active munitions LAP line, but there are plans for the entire line to be demolished. There are no perennial surface water features within the Line 3A site boundary. The site is closed to recreational activities; therefore, hunting is not permitted within the site boundary. As previously discussed, groundwater is not currently being used as a potable water source; however, the HHRA for Line 3A evaluated potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater. Therefore, ingestion and dermal contact exposures to COPCs in groundwater were estimated for future hypothetical residents; inhalation exposures to site groundwater are incomplete because no COPCs were identified for the VI pathway. Culverts are located at Line 3A; therefore, potential ingestion, dermal contact, and inhalation exposures to shallow groundwater in a trench are complete for future construction/utility workers. As discussed in Section 4.3.1, the hypothetical residential scenario is protective of all other activities; therefore, potential exposures and risks and hazards to future site workers and construction/utility workers are estimated in the HHRA only if the estimated risks or hazards for a hypothetical residential scenario exceed acceptable risk or hazard levels and COCs are identified for a residential scenario. The potential exposure pathways quantified in the HHRA are included in Appendix A-6, Attachment 1 (Table 1) and in Figure 5.5-7. The following receptor scenarios were quantified in the HHRA for Line 3A:

- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion and dermal contact.

Risks and hazards for site workers and construction/utility workers were not quantified in the HHRA because the estimated risks and hazards for a hypothetical residential scenario did not exceed acceptable risk or hazard levels, and COCs were not identified for a residential scenario.

In accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b), groundwater EPCs are typically calculated based on the data collected in the core of a plume. Monitoring wells within the core of the RDX plume groundwater data set consist of 12 wells: JAW-15, JAW-16, JAW-17, JAW-18, JAW-20, JAW-21, JAW-22, L3A-MW4A, L3A-MW4B, L3A-MW5A, L3A-MW5B, and L3A-MW7. One COPC (RDX) had at least four detected concentrations and eight samples available in the RDX plume groundwater data set; therefore, the UCL was calculated for this COPC using USEPA's ProUCL software (USEPA, 2016), and the UCL was selected as the EPC. For the other four COPCs (2-amino-4,6-DNT, 4-amino-2,6-DNT, barium, and chromium), the MDC was selected as the EPC because fewer than four detected concentrations and/or eight samples were available in the groundwater dataset, and a reliable UCL could not be estimated due to the limited number of detected concentrations. The groundwater EPCs used to estimate the chemical daily intakes are provided in Appendix A-6, Attachment 1 (Table 3.1). The ProUCL output for RDX is provided in Appendix A-6, Attachment 3.

The exposure factors used in the daily intake calculations for the future hypothetical residential scenario are included in Appendix A-6, Attachment 1 (Table 4.1). The primary references for the exposure factor values are the standard default exposure factors presented in the HHEM *Update of Standard Default Exposure Factors* (USEPA, 2014a).

One COPC (chromium) was identified as acting with an MMOA in site media. The ADAFs and exposure assumptions used to calculate adjusted daily intakes for chromium are provided in Appendix A-6, Attachment 1 (Table 4 Supplement A).

5.5.6.4 Toxicity Assessment

The oral toxicity values (CSFs and RfDs) used in the HHRA were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as provided in Section 4.3.1. Noncancer toxicity values for the COPCs identified at Line 3A are provided in Appendix A-6, Attachment 1 (Table 5.1). Cancer toxicity values for the COPCs are provided in Appendix A-6, Attachment 1 (Table 6.1).

5.5.6.5 Risk Characterization

The risk characterization for Line 3A was completed using a four-step process, as discussed in Section 4.3.1. The results of each step are discussed below.

Step 1: Total Combined Risks and Hazards from Site-related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculating receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. The estimated risks and hazards for a hypothetical residential scenario are summarized in Table 5.5-12.

Table 5.5-12. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 3A
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-6, Attachment 1	Exposure Medium	COPC/Chemical	Line 3A		
				EPC [b]	**ELCR**	**HI**
Hypothetical Resident (Adult)	7.1 and 9.1	Groundwater (Tap water)	2-Amino-4,6-DNT	0.97	NA	0.3
			4-Amino-2,6-DNT	1.1	NA	0.3
			RDX	106.6	NA	0.8
			Barium	434	NA	0.07
			Chromium[c]	2.3	NA	0.03
	Total HI (Groundwater—Tap Water)				**NA**	**2[d]**
Hypothetical Resident (Child)	7.2 and 9.2	Groundwater (Tap water)	2-Amino-4,6-DNT	0.97	NA	0.5
			4-Amino-2,6-DNT	1.1	NA	0.6
			RDX	106.6	NA	1
			Barium	434	NA	0.1
			Chromium[c]	2.3	NA	0.04
	Total HI (Groundwater—Tap Water)				**NA**	**3[d]**
Hypothetical Resident (Adult/Child Aggregate)	7.3 and 9.3	Groundwater (Tap water)	2-Amino-4,6-DNT	0.97	NA	NA
			4-Amino-2,6-DNT	1.1	NA	NA
			RDX	106.6	1E-04	NA
			Barium	434	NA	NA
			Chromium[c]	2.3	5E-05	NA
	Total HI (Groundwater—Tap Water)				**2E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] Evaluated as hexavalent chromium

[d] No individual target organ HI exceeds 1; Appendix A-6, Attachment 1 (see Tables 9.1 and 9.2)

NA = not applicable

RME = reasonable maximum exposure

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculating receptor-specific ELCRs and HIs for naturally occurring chemicals. One COPC (chromium) was identified as a naturally occurring chemical in site groundwater at Line 3A, as discussed in Section 5.5.4. The MDC of chromium in groundwater was less than the BTV. The estimated risks and hazards for chromium in groundwater for a future hypothetical residential scenario are provided in Table 5.5-13. Since chromium is a naturally occurring chemical, it is not identified as a final COC for Line 3A and is not discussed further in the HHRA after this step.

Table 5.5-13. Summary of Total Combined Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 3A
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-6, Attachment 1	Exposure Medium	Chemical	Line 3A		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.4 and 9.4	Groundwater (Tap water)	Chromium[c]	2.3	NA	0.03
	Total HI (Groundwater—Tap Water)				**NA**	**0.03**
Hypothetical Resident (Child)	7.5 and 9.5	Groundwater (Tap water)	Chromium[c]	2.3	NA	0.04
	Total HI (Groundwater—Tap Water)				**NA**	**0.04**
Hypothetical Resident (Adult/Child Aggregate)	7.6 and 9.6	Groundwater (Tap water)	Chromium[c]	2.3	5E-05	NA
	Total HI (Groundwater—Tap Water)				**5E-05**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] Evaluated as hexavalent chromium

COPC = chemical of potential concern

ELCR = excess lifetime cancer risk

EPC = exposure point concentration

HI = hazard index

NA = not applicable

RME = reasonable maximum exposure

µg/L = microgram per liter

Step 3: Risk Characterization of Site-related COPCs

Step 3 consists of calculating receptor-specific ELCRs and HIs associated with site-related COPCs. Four site-related COPCs (barium, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX) were identified for groundwater at Line 3A. The estimated risks and hazards for COPCs in groundwater for a hypothetical resident are provided in Table 5.5-14.

Table 5.5-14. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs—Line 3A
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-6, Attachment 1	Exposure Medium	COPC	Line 3A		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.7 and 9.7	Groundwater (Tap water)	2-amino-4,6-DNT	0.97	NA	0.3
			4-amino-2,6-DNT	1.1	NA	0.3
			RDX	106.6	NA	0.8

Table 5.5-14. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs—Line 3A
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-6, Attachment 1	Exposure Medium	COPC	Line 3A		
				EPC [b]	ELCR	HI
			Barium	434	NA	0.07
	Total HI (Groundwater—Tap Water)				**NA**	**2[c]**
Hypothetical Resident (Child)	7.8 and 9.8	Groundwater (Tap water)	2-amino-4,6-DNT	0.97	NA	0.5
			4-amino-2,6-DNT	1.1	NA	0.6
			RDX	106.6	NA	1
			Barium	434	NA	0.1
	Total HI (Groundwater—Tap Water)				**NA**	**3[c]**
Hypothetical Resident (Adult/Child Aggregate)	7.9 and 9.9	Groundwater (Tap water)	2-amino-4,6-DNT	0.97	NA	NA
			4-amino-2,6-DNT	1.1	NA	NA
			RDX	106.6	1E-04	NA
			Barium	434	NA	NA
	Total HI (Groundwater—Tap Water)				**1E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water and/or shallow groundwater)—micrograms per liter.

[c] No individual target organ HI exceeds 1; Appendix A-6, Attachment 1 (see Tables 9.7 and 9.8).

NA = not applicable

RME = reasonable maximum exposure

Step 4: Final COC Determination

The total ELCRs and HIs estimated for groundwater based on a future hypothetical residential scenario (adult and child) did not exceed USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} or HI target of 1. Therefore, no COCs were identified for groundwater at Line 3A, and Line 3A qualifies for an NFA decision for groundwater based on the results of the HHRA.

5.5.6.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. The general uncertainties associated with the HHRAs for the sites in this RI report are provided in Section 4.3.1. This section provides additional site-specific uncertainties associated with the HHRA for Line 3A that are not included in Section 4.3.1.

Total chromium was initially identified as a COPC in groundwater because the MDC for total chromium exceeded the tap water RSL for hexavalent chromium. It is likely that some or all the total chromium concentrations are in the trivalent chromium form. All the groundwater chromium concentrations are less than the tap water RSL for trivalent chromium and the MCL and BTV for total chromium. Using the hexavalent chromium RSL to evaluate total chromium in the COPC selection process was a conservative approach in the HHRA. Total chromium was determined to be naturally occurring in groundwater at Line 3A.

Chemicals that were 100 percent not detected in an exposure medium were not included in the COPC identification process; however, they were evaluated in a separate screening to determine whether elevated nondetected results were present in site media. The analysis of the nondetected chemicals at Line 3A is provided in Appendix A-6, Attachment 4. In summary, two metals (arsenic and cadmium), three explosives (2,4-DNT, 2,6-DNT and 2-nitrotoluene), and 13 VOCs had DLs and/or RLs exceeding groundwater SLs. Although the DLs and RLs for these nondetect chemicals are greater than the SLs, based on the age of the data, laboratory limitations, and comparison to historically detected chemicals in groundwater at IAAAP, further consideration of nondetect chemicals does not appear warranted in the Line 3A HHRA.

5.5.6.7 Summary of HHRA

An HHRA was prepared for Line 3A to evaluate potential current and future health risks from exposure to chemicals in site groundwater. Line 3A is an active munitions LAP line. There are no perennial surface water features within the Line 3A site boundary. The site is closed to recreational activities; therefore, hunting is not permitted within the site boundary.

The following potential human receptors were identified in the HHRA for Line 3A:

- **Current Site Workers.** Current site workers could be exposed to indoor air (if volatile chemicals are present in groundwater and migrating to indoor air) in active buildings at Line 3A.

- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 3A and could be exposed to indoor air (if volatile chemicals are present in groundwater and migrate to indoor air) in buildings.

- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 3A.

- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 3A and could be exposed to indoor air (if volatile chemicals are present in groundwater and migrate to indoor air) in buildings.

Potential exposures and risks and hazards to future site workers and construction/utility workers were estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk and hazard levels and COCs were identified for a residential scenario.

The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are as follows:

- Groundwater (potable use):
  - Naturally occurring: chromium.
  - Site-related: barium, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX.
- Groundwater (vapor intrusion): none.

The risk characterization for Line 3A was completed using a four-step process, as discussed in Section 4.3.1. Step 1 presents the total combined risks and hazards[2] from site-related COPCs and naturally occurring chemicals, as summarized in Table 5.5-12. Step 2 presents the risks and hazards from naturally

[2] In the risk characterization, chromium (total) concentrations were assumed to be hexavalent chromium due to the lack of speciated data.

occurring chemicals, as summarized in Table 5.5-13. Step 3 presents the risks and hazards from site-related chemicals, as summarized in Table 5.5-14.

No unacceptable groundwater risks or hazards were identified in Step 3 for hypothetical residents. Therefore, in Step 4, no COCs were identified for groundwater at Line 3A, and Line 3A qualifies for an NFA decision for groundwater based on the results of the HHRA.

5.5.7 Ecological Risk Assessment

The ERA for groundwater at Line 3A is presented herein, beginning with Step 1 of the ERA process (to determine whether there are complete exposure pathways). Soil at Line 3A is already addressed under the remedy for OU-1. There are no perennial surface water features within the Line 3A boundary, so there are no complete exposure pathways for sediment or surface water. A summary of the Line 3A relationship with the Long Creek and Skunk River watersheds is discussed in the watershed ERA (CH2M, 2022) and included in Appendix I.

Groundwater is present onsite, but ecological receptors are not exposed directly to groundwater; nevertheless, groundwater is a transport medium, and contaminated groundwater has potential to migrate to and discharge to surface water bodies. Although there are ditches onsite for drainage purposes, these are not perennial waterbodies and do not provide suitable habitat for ecological receptors. Furthermore, as previously noted, there is no connectivity between the ditch and groundwater. Given the lack of perennial surface water bodies on Line 3A, the groundwater-to-surface-water exposure pathway is incomplete. Because there are no complete exposure pathways for ecological receptors for Line 3A, no ecological adverse effects are likely. Therefore, no additional analyses from an ecological perspective are warranted.

5.5.8 Conclusions and Recommendations

An RI was conducted for Line 3A to refine the nature and extent of contamination in groundwater from historical activities and assess for potential unacceptable risk to human health and the environment. Soil at this site was addressed under the remedial action for OU-1 and is not covered under this RI for OU-6. Analytical data available for groundwater at Line 3A includes explosives, VOCs, SVOCs, PAHs, PCBs, pesticides, and metals. Of these, explosives and metals were identified as site-related chemicals of interest based on historical site operations and a comparison of concentration data to site characterization PALs (listed in Appendix F) and BTVs.

In groundwater, no metal was detected at a concentration greater than its site characterization PAL or BTV (if available). During the most recent groundwater monitoring well sampling events in 2018 and 2019, only one explosive (RDX) was detected at a concentration greater than its site characterization PAL. RDX is present as one large plume at Line 3A, and exceedances were observed at six shallow overburden wells and two deep overburden locations during the RI. Concentrations of RDX have increased between 2008 and 2018 at several monitoring wells at Line 3A. Therefore, continuing sources of RDX may still be present at Line 3A. This includes the two excavation areas where soil could not be removed to OU-1 remedial goals.

An HHRA and an ERA were conducted to quantify potential risks and hazards to human health and the environment from exposure to contaminants at Line 3A. The following conclusions were made based on the risk assessments:

- No unacceptable groundwater risks or hazards were identified for hypothetical residents at Line 3A.
- The ERA concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective at Line 3A.

Based on the results of the RI and risk assessments, NFA is warranted for groundwater at Line 3A. It is recommended that NFA be presented as the preferred remedy for IAAP-004G in a Proposed Plan under OU-11.

5.6 IAAP-006G_Lines 5A and 5B Ammo Assembly Groundwater (19105.1067)

This subsection summarizes RI activities at Lines 5A/5B. This report documents the RI for groundwater at Lines 5A/5B (IAAP-006G). Soil is addressed under the remedy for OU-1 (IAAP-006) (Leidos, 2018). There are no perennial surface water features within the Lines 5A/5B boundary.

5.6.1 Background

5.6.1.1 Site Description

Lines 5A and 5B are located in the north-central portion of the IAAAP and are bounded by Yard L to the north, Line 1 to the east, Lines 4A and 4B to the south, and Yard J to the west (Figure 5.6-1). Line 5A encompasses approximately 33 acres in the Brush Creek watershed and historically contained 17 buildings. Line 5B encompasses approximately 41 acres in the Long Creek watershed, west of Line 5A, and historically contained 18 buildings. All buildings at both Lines 5A and 5B have been demolished as part of IAAAP's facility demolition plan (Figure 5.6-1; IAAAP, 2023). However, there are future plans for new construction at Lines 5A/5B. The area surrounding the former building footprints is predominantly covered with grass, with the exception of a few roads. As shown on Figure 5.6-1, there is another IAAAP environment site (Central Test Area) located within the southern portion of the Lines 5A/5B site boundary. Due to possible munitions, this area is investigated as a separate site (IAAP-046) and not considered part of Lines 5A/5B (IAAP-006G). The Central Test Area (IAAP-047G) is included in the OU-11 RI report (CH2M, 2021).

5.6.1.2 Operational History

Line 5A

Line 5A was constructed in 1941 and was operated as a booster production line from 1942 until the end of World War II, in 1945, when production was suspended. Operations resumed in 1949, just before the Korean War, for pelletizing TNT, miscellaneous demolition blocks, and grenades, and assembling explosive components (JAYCOR, 1996). However, it is unclear from available documents whether production was ongoing at Line 5A between 1952 and 1963. Demolition blocks were produced between 1963 and at least 1988 using RDX (ECC, 2001b). The waste materials resulting from the explosives loading operation in Line 5A were explosives-contaminated wastewater and contaminated airborne particles (ECC, 2001b).

A wastewater pollution abatement program consisting of the installation of pinkwater treatment plants was completed in 1973 (Mason & Hanger–Silas Mason, 1973). Process wastewater was discharged from Building 5A-140-3 through NPDES-permitted Outfall 51, to a ditch that flows south to an intermittent tributary of Brush Creek at the southern boundary of the site (Figure 5.6-1) (Harza, 2001). This outfall is no longer used (Tetra Tech, 2006b). It is unknown what was done with process wastewater prior to 1973.

Production at Line 5A ceased sometime between 1988 and 1991 (ECC, 2001a), and the site is no longer permitted for NPDES discharge. The site was put on layaway status at the end of 2000 (ECC, 2001b) and is currently inactive. All buildings have been demolished.

Line 5B

Line 5B was also constructed in 1941 and was used for pelletizing adaptor-boosting tetryl and assembling explosives components between 1942 and 1945. Production resumed in 1949 during the Korean War, and was intensified in 1961 during the Vietnam War. Line 5B was later rented to Advanced Environment Technology for destructive disposal of ammunition until approximately 2005.

A wastewater pollution abatement program consisting of the installation of pinkwater treatment plants was completed in 1973 (Mason & Hanger–Silas Mason, 1973). Process wastewater was discharged through NPDES outfall 52 to a ditch at the north end of the site. It is unknown what was done with process wastewater prior to 1973. Line 5B is currently inactive and is no longer permitted for NPDES discharge. The buildings at Line 5B have been demolished (Figure 5.6-1).

5.6.1.3 Previous Investigations and Remedial Actions

Numerous investigations have been conducted at IAAAP since the 1980s. Table 5.6-1 summarizes the previous investigations and remedial actions conducted at Lines 5A/5B, including conclusions and recommendations. There are no perennial surface water features within the site boundaries. However, results from surface water and sediment samples collected from the intermittent features outside are discussed in Table 5.6-1 to support the CSM. Similarly, although soil at Lines 5A/5B has already been addressed under OU-1, previous investigations for soil are also presented in Table 5.6-1 to support the CSM.

This report summarizes the RI for groundwater at Lines 5A/5B (IAAP-006G). Previous investigations pertinent to the RI for groundwater are listed in Table 5.6-2; additional details on these investigations (e.g., including a more-detailed description of work completed, as well as work not pertinent to this RI), are included in Table 5.6-1. Previous groundwater sampling locations are shown on Figure 5.6-2.

Table 5.6-2. Excerpts from the Previous Investigations and Remedial Actions Table for Lines 5A/5B
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	The principal explosives used at both lines were TNT, RDX, and tetryl. It was recommended that soil, and possibly sediment, sampling be conducted near treatment sumps and drainage pathways.
Facility-wide Site Inspection (JAYCOR, 1992)	No groundwater samples were collected during the facility-wide site inspection. It was recommended that Lines 5A and 5B be further investigated in the Phase I RI to determine the extent of metals and explosives contamination in soil.
Facility-wide Phase I RI (JAYCOR, 1993a)	No groundwater samples were collected during the Phase I RI. No Phase II RI activities were proposed for Lines 5A and 5B.
Follow-on RI (JAYCOR, 1996)	Groundwater samples were collected from four new monitoring wells and analyzed for explosives, metals, PCBs, pesticides, SVOCs, and VOCs. Only BEHP and manganese were detected at concentrations greater than comparison criteria; the RI concluded that the metals detections were likely due to suspended solids.
Periodic Groundwater Monitoring (multiple reports)	Groundwater samples were collected from eight wells during multiple sampling events between 1996 and 2008 and analyzed for explosives, metals, SVOCs, and/or VOCs, depending on the sampling event. Metals, BEHP, and explosives were detected at concentrations greater than SLs. However, metal exceedances were observed only prior to October 2008, and BEHP was detected at a concentration greater than its MCL only once in two wells. Six explosives (RDX, TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2,4-DNT, and 2,6-DNT) exceeded SLs at Line 5A. Only RDX exceeded SLs at Line 5B (well 5B-MW1) through 2008.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	The report noted that no groundwater samples had been collected from the downgradient sides of the site (southeast at Line 5A, southwest at Line 5B) to monitor migration of contamination. Additional groundwater monitoring for explosives was recommended for wells 5A-MW1, 5A-MW2, 5B-MW1, and JAW-606. DPT groundwater samples were proposed at the southeast side of Line 5A and southwest of well 5B-MW1 to determine whether there was horizontal migration of the plume in the direction of Brush Creek or Long Creek, respectively.

Table 5.6-2. Excerpts from the Previous Investigations and Remedial Actions Table for Lines 5A/5B
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
OU-6 SRI (Tetra Tech, 2012a)	Groundwater samples were collected from two temporary wells and analyzed for explosives to delineate the explosives plumes. TNT was detected at a concentration less than its tap water RSL in the downgradient temporary well at Line 5A. No explosives were detected in the downgradient temporary well at Line 5B.

The Phase 2 remedial action completion report for OU-1 soils (ECC, 2001b) identified explosives, metals, total petroleum hydrocarbons, VOCs, SVOCs, and pesticides as soil COCs. However, TNT, RDX, and DNTs were identified as the primary COCs. Areas at Lines 5A and 5B with elevated explosives concentrations (primarily RDX and TNT) were identified surrounding former sumps and wastewater discharge locations, and in associated drainageways near production building foundations. In 1995, contaminated soil was excavated as part of a sump removal action. In 1999, contaminated soil at Lines 5A and 5B was excavated in accordance with the remedial action objectives established in the OU-1 ROD. Of note, RDX and TNT soil RGs are based on leachability protection levels. Excavated areas are shown on Figure 5.6-1. Confirmation sampling indicated that no soil with concentrations greater than OU-1 RGs remains. Because soil was remediated to its leachability goals for RDX and TNT, the sources to groundwater in the removal areas have been addressed. Lines 5A/5B are also subject to OU-1 LUCs (Leidos, 2019). There is no continuing source of soil contamination to groundwater.

Additional soil investigation was conducted at Lines 5A and 5B in 2022 to determine if contaminated soil exists beneath recently demolished buildings and delineate the contamination in vadose zone soil that exceeds OU-1 RGs (TAC, 2022). The IAAAP is currently undergoing a modernization effort involving the demolition of numerous buildings throughout the Plant. The analytical results will be used to support future remedial design for soil contaminants under OU-1, and would be considered when developing the FS for OU-6, if a new soil source to groundwater was identified.

5.6.2 2018–2020 Remedial Investigation Activities

Additional field work was conducted at Lines 5A and 5B to resolve data gaps needed to complete the RI for groundwater. As documented in the final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 2)* (CH2M, 2018a), the horizontal extent of explosives in groundwater was not adequately characterized to the north and southeast of 5A-MW2 at Line 5A or to the north and southwest of 5B-MW1 at Line 5B (Figure 5.6-2). To address this data gap, six new monitoring wells were installed and two DPT borings were advanced around historical sample locations 5A-MW2 and 5B-MW1 (Figure 5.6-2). To supplement the existing dataset, eight existing monitoring wells were also sampled as part of this investigation. Fieldwork completed at Lines 5A and 5B was conducted in accordance with the UFP-QAPP (CH2M, 2018a).

Between June 7 and June 22, 2018, six monitoring wells (5A-MW3, 5A-MW4, 5A-MW5, 5A-MW6, 5B-MW3, and 5B-MW4) were installed and two DPT borings were advanced at Lines 5A and 5B with the following data objectives:

- Two intermediate zone overburden monitoring wells (5A-MW3 and 5B-MW3) were installed to delineate the vertical extent of the explosives plumes. Monitoring well 5A-MW3 was installed adjacent to 5A-MW2 at Line 5A and monitoring well 5B-MW3 was installed adjacent to 5B-MW1 at Line 5B (Figure 5.6-2).
- At Line 5A, three shallow zone overburden monitoring wells (5A-MW4, 5A-MW5, and 5A-MW6) were installed.

  - Monitoring wells 5A-MW4 and 5A-MW5 were installed to refine the horizontal extent of the explosives plume to the north and southeast (downgradient), respectively.
  - Monitoring well 5A-MW6 was installed near the soil excavations that occurred in the vicinity of former Building 5A-140-1, to evaluate whether groundwater had been impacted.
- At Line 5B, one shallow zone overburden well (5B-MW4) was installed and two DPT borings were advanced.
  - Monitoring well 5B-MW4 was installed to refine the horizontal extent of the explosives plume to the southwest (downgradient).
  - Groundwater samples were collected from two DPT borings (5B-DP1 and 5B-DP2). Boring 5B-DP1 was located just downgradient of the excavation by former Building 5B-29 to evaluate whether groundwater had been impacted. Boring 5B-DP2 was located to the northeast (upgradient) of 5B-MW1 to refine the horizontal extent of the explosives plume.

Contingency monitoring wells were also proposed for consideration in the final UFP-QAPP (CH2M, 2018a) if elevated explosives concentrations were observed in the new intermediate zone overburden wells to further define the vertical extent of the explosives plumes. However, these contingency locations were not warranted since explosives were not detected in the new intermediate zone monitoring wells (5A-MW3 and 5B-MW3).

5.6.2.1 DPT Groundwater Sampling

On June 21, 2018, groundwater samples were collected from two DPT borings (5B-DP1 and 5B-DP2) at Line 5B. Prior to sample collection, the borings were drilled to 15 feet bgs and continuous soil samples were collected for geologic logging and to assess for water-bearing zones; boring logs are provided in Appendix C. A DPT groundwater sample was collected at each boring location from the shallow overburden zone between depths of 11.3 and 15 feet bgs sampled using a screen point sampler and peristaltic pump. Groundwater samples were submitted for explosives analysis by Method SW8330A. Data were managed and validated as discussed in Section 4.3. Laboratory reports are provided in Appendix B.

5.6.2.2 Monitoring Well Installation and Sampling

Monitoring well locations were drilled with an HSA drilling rig between June 7 and June 22, 2018, in accordance with Section 4.2.4. The four shallow monitoring wells (5A-MW4, 5A-MW5, 5A-MW6, and 5B-MW4) were drilled to approximately 20 feet bgs; the two deep monitoring wells (5A-MW3 and 5B-MW3) were drilled to approximately 60 feet bgs. At each boring, continuous soil samples were collected and logged for lithologic characterization. Boring logs are provided in Appendix C.

Each monitoring well was completed with a 2-inch-nominal-diameter Schedule 40 PVC screen and riser and 0.5-foot Schedule 40 PVC end cap. Monitoring wells were screened with a machine-slotted, 0.010-inch, 10-foot screen. Shallow wells were screened from 10 to 20 feet bgs and deep wells were screened from 40 to 55 feet bgs for vertical delineation. Each monitoring well was constructed with a certified-clean silica sand filter pack from the base of the borehole to 1 to 4 feet above the top of the screen. A 3- to 5-foot-thick bentonite layer was placed above the filter pack sand and hydrated. The well was grouted to the surface and a steel stick-up well protector was installed and surrounded by three bollards. Well construction details are provided in Tables 5.6-3 and 5.6-4. Well completion diagrams are included in Appendix C. Newly installed monitoring wells were developed on June 26, 2018, in accordance with Section 4.2.5. Well development logs are provided in Appendix C. Monitoring wells were developed through a series of surging and pumping. Groundwater quality parameters (pH, temperature, turbidity, and specific conductivity) were collected during development. Well development logs are included in Appendix C.

The six newly installed monitoring wells (5A-MW3, 5A-MW4, 5A-MW5, 5A-MW6, 5B-MW3, and 5B-MW4) and eight existing monitoring wells (5A-MW1, 5A-MW2, 5B-MW1, 5B-MW2, JAW-606, JAW-607, JAW-608, and JAW-609) were sampled via low-flow purging and sampling techniques between July 20 and July 24, 2018. All samples were analyzed for explosives by Method SW8330B. Purge logs are included in Appendix C. Data were managed and validated as discussed in Section 4.3. Laboratory reports are provided in Appendix B.

Groundwater elevation measurements were obtained from six newly installed and eight existing monitoring wells on December 10, 2019. Tables 5.6-5 and 5.6-6 summarize the water-level measurements from each well at Lines 5A and 5B, respectively.

All IDW generated during activities (soil and purge water) was disposed of in accordance with management activities discussed in Section 4.2.9. Waste management documentation is provided in Appendix D.

New monitoring wells were surveyed by Bruner, Cooper, and Zuck, Inc., licensed Iowa surveyors, on September 24, 2018, in accordance with Section 4.2.8. Survey information is included in Appendix E.

5.6.3 Environmental Setting

5.6.3.1 Topography and Surface Drainage

Topography at Lines 5A and 5B is generally flat, with a gentle slope toward the southeast. Surface drainage flows into ditches near site boundaries.

At Line 5A, ditches north, east, and south of the site ultimately discharge into east- or south-flowing intermittent tributaries of Brush Creek. The southern ditch/tributary discharges into a constructed pond approximately 3,300 feet southeast of Line 5A. Prior to the construction of the pond in 1996, discharge would have been into Brush Creek (ECC, 2001b).

Ditches on the northern side of Line 5B ultimately discharge into a west-flowing intermittent tributary of Long Creek, approximately 1,000 feet west of the site. Ditches on the southern side of the site direct runoff through Line 4B and ultimately discharge it to a south-flowing intermittent tributary of Long Creek approximately ¾ mile to the south.

5.6.3.2 Geology and Hydrogeology

The overburden at Lines 5A and 5B is characterized by glacial till consisting primarily of fat clay and clay with occasional discontinuous silty sand lenses (Figure 2-5). The geology observed at the new monitoring wells and DPT borings (Appendix C), which consisted primarily of clays with trace sand and gravel, was consistent with this interpretation. Sand lenses were observed at 5B-MW3 between 48 and 53 feet bgs; however, these sand lenses were not observed at the same depth in the boring for 5A-MW3. The overburden is underlain by bedrock, which has historically been encountered at 80 feet bgs at Line 5A, consisting of limestone of the upper Warsaw Formation. During the 2018 investigation activities, bedrock was not encountered at Lines 5A and 5B up to a depth of 55 feet bgs.

Based on historical gauging data, overburden groundwater at Lines 5A and 5B occurs at depths ranging from approximately 3 to 6 feet bgs and is generally under unconfined conditions resulting in an approximate 75-foot saturated thickness. Bedrock groundwater is under confined conditions. During the 2019 RI gauging event, overburden water levels ranged from 4 to 6 feet bgs at Line 5A (Table 5.6-5), and from 5 to 9 feet bgs at Line 5B (Table 5.6-6). The depth to groundwater in the bedrock well JAW-609 was measured at 50 feet bgs. Figure 5.6-3 presents the December 2019 potentiometric surface map at the sites. A groundwater divide is present between Line 5A and Line 5B given that the site straddles the Brush Creek–Long Creek watershed boundary (see inset on Figure 5.6-1). As shown on Figure 5.6-3, groundwater flow in 2019 was to the southeast at Line 5A, and to the southwest at Line 5B. Facility-wide potentiometric data indicate that groundwater flow in the bedrock is generally to the south. Horizontal hydraulic gradients in groundwater are considered to be low and a downward vertical gradient is suggested by the differences in water elevations in overburden and bedrock groundwater at the JAW-606/JAW-609 well pair (Figure 5.6-3). Hydraulic conductivity has not been calculated at Lines 5A and 5B. Values in this area are considered to be consistent with *K* values calculated in other wells screened in bedrock and bedrock combinations (an average of 2.3 feet/day), as discussed in Section 3.6.

5.6.4 Nature and Extent of Contamination

This subsection describes the nature and extent of contamination at Lines 5A and 5B. Soil has been addressed under OU-1 but is discussed briefly to inform the CSM for potential groundwater contaminant source. No perennial surface water or sediment is present at Lines 5A/5B.

The sources of contamination at Lines 5A and 5B are attributed to the historical explosives-related operations at the site buildings and process wastewater. The principal explosives used at both lines were TNT and tetryl. A survey of facilities for waste materials and hazardous wastes listed TNT, RDX, and PBX as some of the explosives processed at Line 5A. The listed solvents include acetone, xylene paint thinner, and lacquer thinner (JAYCOR, 1994a). Although no spills were recorded at Line 5A, historical releases may have occurred at Buildings 5A-140-1, 5A-140-2, and 5A-140-3 (ammunition wash facilities); 5A-26 (blender room); 5A-28 (pressing area); and 5A-29 (assembly building) (Tetra Tech, 2006b). Historical releases at Line 5B may have occurred at Buildings 5B-140-1, 5B-140-2, and 5B-140-3 (ammunition wash facilities) and Buildings 5B-28 and 5B-29 (loading plants). Additionally, process wastewater generated at Lines 5A and 5B was formally discharged through NPDES Outfalls 51 and 52 (Harza, 2001). Operations at the site ended by 2005.

5.6.4.1 Groundwater

Groundwater samples have been collected at Lines 5A and 5B as part of several investigations between 1995 and 2018. Eleven shallow overburden, two intermediate overburden–bedrock interface, and one bedrock monitoring well are present at Lines 5A/5B (Figure 5.6-2). Historical groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, and metals. Neither pesticides nor PCBs were detected in groundwater samples. VOCs, SVOCs, pesticides, and metals detections have been inconsistent and at concentrations less than their SLs. Only explosives have been consistently detected in groundwater samples and are considered the primary chemicals of interest. These chemicals are consistent with historical site operations.

During the current RI, groundwater samples were collected at Lines 5A and 5B from 14 monitoring wells and two DPT borings and analyzed for explosives (Figure 5.6-2). Tables 5.6-7 and 5.6-8 present the concentrations of chemicals detected in groundwater samples during recent groundwater sampling events (2000 through 2018). Statistical summary tables of the analytical results used in the HHRA are included in Section 5.6.6. Summary tables of all the analytical results (including nondetects) from the 2018 RI activities are provided in Appendix G. Summary tables of all historical analytical results from Lines 5A and 5B are provided in Appendix H.

VOCs

Six VOCs have been detected in groundwater at Lines 5A and 5B. Five VOCs (methylene chloride, heptacosane, nonacosane, octacosane, and Freon 113) have been detected at Line 5A, and three VOCs (methylene chloride, chloroform, and Freon 113) have been detected at Line 5B (Appendix H). Between 2000 and 2004 (the last sampling event for which VOCs were analyzed), the only VOC detected in groundwater was Freon 113. Concentrations of Freon 113 did not exceed the site characterization PAL (Tables 5.6-7 and 5.6-8).

SVOCs

Only one SVOC has been detected in groundwater at Lines 5A and 5B. Bis(2-ethylhexyl)phthalate has been detected sporadically in groundwater samples at both lines between 1995 and 2000. However, in 2001 (the last event that SVOCs and PAHs were analyzed), bis(2-ethylhexyl)phthalate was not detected in any groundwater samples. Bis(2-ethylhexyl)phthalate is a plasticizer that is used in many common products, including PVC, plastic syringes, and pipette tips. It is not known to have been used at IAAAP. Therefore, its historical presence is attributed to laboratory or sampling contamination.

Explosives

Between 2000 and 2018, 11 explosives were detected at Lines 5A and 5B (Tables 5.6-7 and 5.6-8). The results for the most recent sampling event (2018) are discussed for each line below.

In 2018, nine explosives were detected in groundwater at Line 5A. Of these, only three explosives (RDX, 4-amino-2,6-DNT, and 2-amino-4,6-DNT) exceeded their site characterization PALs (Table 5.6-7). These compounds exceeded PALs at only one shallow overburden well (5A-MW2) and were either not detected or did not exceed PALs in shallow overburden monitoring wells surrounding 5A-MW2 (5A-MW1, 5A-MW4, 5A-MW5 and JAW-606; Figure 5.6-4). Explosives were also not detected in newly installed shallow overburden well 5A-MW6, indicating that historical soil contamination near former Building 5A-29 did not impact groundwater. No explosives were detected in the newly installed intermediate overburden well (5A-MW3) that is adjacent to 5A-MW2 or in the downgradient bedrock well (JAW-609). Therefore, the explosives plume in groundwater at Line 5A is present only in the shallow overburden aquifer, and the lateral and vertical extent of contamination is limited.

In 2018, three explosives were detected in groundwater at Line 5B. Of these, only RDX exceeded its site characterization PAL (Table 5.6-8). This compound exceeded the PAL at only one shallow overburden well (5B-MW1), which is adjacent to the soil removal areas and former sumps associated with former Buildings 5B-28 and 5B140-3 (Figure 5.6-4). RDX was either not detected or did not exceed its PALs in shallow overburden monitoring wells surrounding 5B-MW1 (5B-MW2, 5B-MW4, JAW-607, and JAW-608) and was not detected in the DPT groundwater samples (5B-DP1 and 5B-DP2). No explosives were detected in the new intermediate overburden monitoring well (5B-MW3) that is adjacent to 5B-MW1. Therefore, the explosives plume in groundwater at Line 5B is present only in the shallow overburden aquifer, and the lateral and vertical extents of contamination is limited.

Metals

Between 2000 and 2004 (the last sampling event in which metals were analyzed), 13 metals were detected at Lines 5A and 5B. Results of these sampling events are summarized below.

At Line 5A, 13 metals were detected in groundwater (Table 5.6-7). Of these, only one metal (lead) was detected at a concentration greater than its site characterization PAL and BTV in groundwater. Lead was detected at a concentration greater than its PAL (15 µg/L) and BTV (18.05 µg/L) at one location (5A-MW2) in May 2000, with a concentration of 22.8 µg/L. Lead was not detected or was detected at a concentration less than its PAL and BTV in this well during subsequent monitoring events in October 2000, 2001, 2002, 2003, and 2004.

At Line 5B, 11 metals were detected in groundwater (Table 5.6-8). However, all metals concentrations were less than their respective site characterization PALs and BTVs (if available) in groundwater. Concentrations of some metals may be naturally elevated in the environment, and may not indicate a CERCLA-regulated release. Several metals (such as cadmium, chromium, and manganese) were detected at Lines 5A and 5B at levels less than their BTVs and are therefore considered to be consistent with background and naturally occurring. Although antimony was reported at a concentration greater than its BTV of 2.22 µg/L, it is also considered to be consistent with background and naturally occurring. Antimony exceedances were observed in only two monitoring wells, 5A-MW2 and 5B-MW1, at concentrations of 2.6 B µg/L and 2.8 B µg/L, respectively (Appendix H). Both concentrations just slightly exceed the BTV and are B-qualified, which indicates that antimony was also detected in the associated method and/or calibration blank and these monitoring well concentrations are likely biased high. There is no reported use of antimony at Lines 5A and 5B.

5.6.5 Fate and Transport

This section discusses the fate and transport of site-related chemicals of interest at Lines 5A and 5B. This includes chemicals that were detected at concentrations greater than both their site characterization PAL and BTV (if available) during the last sampling event that those chemicals were analyzed. In groundwater, potential site-related chemicals of interest include explosives (RDX, 4-amino-2,6-DNT, and 2-amino-4,6-DNT). Fate and transport characteristics for these chemicals are described in Section 4.2.

Lines 5A/5B is primarily grass covered with a few roads that lead to the demolished building footprints remaining. The IAAAP site falls within the Brush Creek and the Long Creek watersheds (Figure 2-1). Surface runoff in the eastern half of the site (Line 5A) moves toward an intermittent tributary of Brush Creek, whereas surface runoff in the western half of the site (Line 5B) moves to the southwest toward a tributary to Long Creek (Figure 5.6-3). Contaminants have entered groundwater at Lines 5A and 5B due to the historical discharge of process water from buildings and sumps and the subsequent leaching of chemicals through unsaturated zone soil. The groundwater table at Lines 5A and 5B is shallow, and groundwater in the overburden aquifer was encountered between 4 and 9 feet bgs during the current RI.

Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Because Lines 5A and 5B are located within two watersheds, a groundwater divide is present, and groundwater at Line 5A flows to the southeast, while groundwater at Line 5B flows to the southwest. Given that the overburden aquifer is predominantly composed of clays and the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow. However, the velocity may be faster within the sand seams present with the aquifer.

Natural attenuation mechanisms that are potentially active at Lines 5A and 5B were evaluated. Natural attenuation includes various physical, chemical, or biological processes that under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. A weight-of-evidence approach was used for this evaluation.

- The primary line of evidence that attenuation is occurring at a site is reduction over time in contaminant concentrations or mass, or both. Explosives were detected at concentrations greater than their site characterization PALs in only two monitoring wells at Lines 5A and 5B (5A-MW2 and 5B-MW1). Although RDX was detected at a concentration greater than its PAL at shallow overburden well 5A-MW1 up to 2007, it was not detected at this location in 2008 or 2018. Concentrations of explosives that were detected at levels greater than their site characterization PALs were plotted over time for monitoring wells 5A-MW2 and 5B-MW1 (Figure 5.6-5). The trend graphs indicate that concentrations of explosives increased in both 5A-MW2 and 5B-MW1 following their installation in 2000. However, RDX concentrations have remained relatively stable at 5A-MW2 since 2006 while RDX concentrations have decreased at 5B-MW1 after 2007. This decrease in concentrations indicates that natural attenuation is occurring.
- Anaerobic daughter products of RDX were detected at Line 5A in 2018. Low levels (< 5 µg/L) of MNX, TNX, and DNX were detected at monitoring wells 5A-MW-1 and 5A-MW-2, providing evidence that anaerobic biodegradation of RDX is occurring in the Line 5A area. At Line 5B, MNX was detected at very low levels (< 1 µg/L) in groundwater samples collected at DPT boring 5B-DP2 and monitoring well 5B-MW1. Therefore, some reductive degradation of RDX may also be occurring in the Line 5B area.

- Water quality parameters can be used to evaluate whether the geochemical conditions are conducive to biodegradation. During the current RI, groundwater in the impacted monitoring wells (5A-MW2 and 5B-MW1) was observed under aerobic and oxidizing conditions. DO concentrations were reported in groundwater at levels greater than 1 mg/L, and ORP values were reported at levels greater than +100 mV (Tables 5.6-9 and 5.6-10). The lack of nitrite and sulfide in groundwater samples may also be indicative of more oxidizing, as opposed to reducing conditions. pH values were relatively neutral (between 6 and 7), which is favorable for biological activity. Under these geochemical conditions, anerobic biodegradation of explosives, particularly RDX, would be less favorable. Nevertheless, the presence of anerobic RDX daughter products (MNX, DNX, and TNX) indicates that anaerobic biodegradation has occurred.
- The physical natural attenuation processes are also likely helping to stabilize the plumes, given the very limited extent of the plumes. While the explosives (RDX, 4-amino-2,6-DNT, and 2-amino-4,6-DNT) in groundwater have relatively low sorption potential, they should be retarded somewhat as they sorb to the clay geology. However, the explosives have limited volatility (Table 4.2-1) and therefore are unlikely to volatilize into soil gas at the interface with the water table.

5.6.6 Human Health Risk Assessment

An HHRA was prepared for Lines 5A and 5B to evaluate potential current and future health risks and hazards from exposure to chemicals in site groundwater. Soil media are not included in the HHRA as it not a component of this RI; the soil RI was conducted under OU-1. As discussed in Section 5.6.1.3, contaminants in soil were removed to meet their OU-1 RGs under multiple removal actions. Therefore, there are no remaining soil sources to groundwater. Surface water and sediment media are not included in the HHRA as perennial surface water features are not present at Lines 5A/5B. The HHRA was conducted in accordance with the final UFP-QAPP (CH2M, 2017a), with the exception of some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final UFP-QAPP. The approach and method used to conduct the HHRA are provided in Section 4.3.1. This section presents the CEM for Lines 5A/5B and provides the results of the four-step evaluation process comprising:

- Data evaluation.
- Exposure assessment.
- Toxicity assessment.
- Risk characterization.

The results of the HHRA are used to determine whether further action is warranted for groundwater at Lines 5A/5B.

5.6.6.1 Conceptual Exposure Model

A description of Lines 5A and 5B, their operational histories, previous investigations, and remedial actions are provided in Sections 5.6.1 and 5.6.2. The soil at Lines 5A/5B is addressed under the remedy for OU-1 (IAAAP Site IAAP-005) (Leidos, 2018) and was not reevaluated in this HHRA. Risks are assessed separately for Lines 5A and 5B due to the large size of each line (Line 5A is 33 acres and Line B is 41 acres), the separation distance between the two lines, and the presence of individual plumes at each line (refer to Figure 5.6-4).

Line 5A was used for production and loading operations; Line 5B was used for explosives component assembly and destructive disposal of ammunition. Lines 5A and 5B are primarily grass covered with a few remaining roads that lead to the cleared/paved areas associated with demolished-building footprints. There are no buildings or perennial surface water features within the Lines 5A/5B site boundary. The site is closed to recreational activities; therefore, hunting is not permitted within the site boundary. There are no potential receptors or potentially complete exposure pathways identified under current site conditions. It is assumed the site could become active or redeveloped in the future. Culverts are present at the site; therefore, potential groundwater exposures by construction/utility workers are complete at Lines 5A/5B.

Groundwater is not currently being used as a potable water source, and there are no plans to use groundwater for potable purposes in the future; however, based on applicable CERCLA policy and guidance, groundwater at Lines 5A/5B is classified as Class IIB, a potential source of drinking water (USEPA, 1989). Therefore, the HHRA for Lines 5A/5B evaluates potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater.

The following potential future human receptors were identified in the HHRA for Lines 5A/5B:

- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Lines 5A/5B. If buildings are constructed onsite, future site workers could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in future buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Lines 5A and 5B.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on its potential future use as a drinking water source at Lines 5A/5B and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in future buildings.

As discussed in Section 4.3.1, potential exposures and risks and hazards to future site workers and construction/utility workers are estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels and COCs are identified for a residential scenario. The human health CEM presenting potential exposure media, exposure points, receptors (future), and exposure routes is provided in Appendix A-7 Attachment 1 (Table 1) and depicted graphically on Figure 5.6-6.

5.6.6.2 Data Evaluation

Data Used in the HHRA

The analytical data used in the HHRA consists of groundwater samples collected at Line 5A and Line 5B; the lines are evaluated separately in the HHRA. Historical groundwater samples collected from 2003 and 2004 and recent samples collected in 2018 were used in the HHRA for Lines 5A and 5B. Historical groundwater samples were analyzed for VOCs, SVOCs, explosives, and metals; recent groundwater samples (2018) were analyzed for explosives. SVOCs were not detected in the 2003 and 2004 groundwater samples. The analytical data for explosives from 2003 and 2004 were not included in the HHRA because explosives data were available from the 2018 sampling event. As stated in the UFP-QAPP (CH2M, 2017a), “Older data (i.e., data collected prior to 2012) may be used in the human health risk assessments if they are still representative of the site (i.e., groundwater flow is slow), chemicals have properties where there would not be a significant reduction in concentrations over time (e.g., metals), or data are conservative for site conditions.” Lines 5A and 5B are no longer operational, as described in Section 5.6.1. Potential soil sources to groundwater have been remediated, as described in Section 5.6.1.3. Due to a lack of continuing sources, historical concentrations in groundwater are expected to have remained stable or even decreased due to natural attenuation processes. Therefore, the assumptions in the final UFP-QAPP still hold. Samples collected prior to 2012 are considered representative of, or more conservative than, current conditions at Lines 5A and 5B.

Table 5.6-11 lists the number of chemicals analyzed and detected in groundwater at Lines 5A and 5B:

Table 5.6-11. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Groundwater (Line 5A)		
Explosives	17	9
Metals, Total	23	18
VOCs	42	2
Groundwater (Line 5B)		
Explosives	17	3
Metals, Total	23	16
VOCs	42	1

Descriptions of the data groupings and samples included in the HHRA are provided in Tables 5.6-12 and 5.6-13, respectively. The analytical data set used in the HHRA is included as Appendix A-7 Attachment 2. The groundwater sampling locations included in the HHRA and the delineation of the explosives plumes are depicted on Figure 5.6-7.

Screening Results for Site-related Chemicals of Potential Concern and Naturally Occurring Chemicals

The approach and SLs used to select the COPCs (site-related COPCs or naturally occurring chemicals) are described in Section 4.3.1. The Line 5A results of the COPC screening process for a future site worker, hypothetical resident, and construction/utility worker potentially exposed to groundwater are provided in Appendix A-7, Attachment 1 (Tables 2.1 through 2.3); the Line 5B results of the COPC screening process for a future hypothetical resident potentially exposed to groundwater are provided in Appendix A-7, Attachment 1 (Tables 2.4 and 2.5). The tap water RSL for hexavalent chromium was used in the COPC screening process for total chromium because the groundwater samples collected at Lines 5A and 5B were not analyzed for hexavalent chromium. The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are summarized in Tables 5.6-14 and 5.6-15.

Table 5.6-14. Summary of COPCs for Lines 5A and 5B—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water (Line 5A)				
Future Site Worker and Future Hypothetical Resident	2-Amino-4,6-DNT	2/8	0.41	6.9
	4-Amino-2,6-DNT	2/8	0.74	43
	RDX	2/8	0.36	6.5
	Antimony	1/1	2.6	2.6
Groundwater to Indoor Air via Vapor Intrusion (Line 5A)—No COPCs				
Shallow Groundwater in a Trench (<10 ft bgs) (Line 5A)				
Future Construction/Utility Worker	2-Amino-4,6-DNT	2/7	0.41	6.9
	4-Amino-2,6-DNT	2/7	0.74	43

Table 5.6-14. Summary of COPCs for Lines 5A and 5B—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
	RDX	2/7	0.36	6.5
	Antimony	1/1	2.6	2.6
Groundwater Used for Tap Water (Line 5B)				
Future Hypothetical Resident	RDX	2/8	0.62	9.4
	Antimony	1/1	2.8	2.8
Groundwater to Indoor Air via Vapor Intrusion (Line 5B)—No COPCs				

Table 5.6-15. Summary of COPCs for Lines 5A and 5B—Naturally Occurring
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water (Line 5A)				
	Cadmium	1/2	1.2	1.2
	Chromium	1/2	0.83	0.83
	Manganese	1/1	60.8	60.8
Groundwater to Indoor Air via Vapor Intrusion (Line 5A)—no COPCs				
Shallow Groundwater in a Trench (<10 ft bgs) (Line 5A)				
	Cadmium	1/2	1.2	1.2
	Chromium	1/2	0.83	0.83
	Manganese	1/1	60.8	60.8
Groundwater Used for Tap Water (Line 5B)				
	Cadmium	1/2	0.55	0.55
	Chromium	2/2	0.82	4.9
Groundwater to Indoor Air via Vapor Intrusion (Line 5B)—no COPCs				

5.6.6.3 Exposure Assessment

Line 5A and Line 5B are both currently inactive, and former buildings have been demolished. However, there are future plans for new construction at Lines 5A/5B. Additionally, the site is closed to recreational activities, and hunting is not permitted within the site boundary. There are no potentially complete exposure pathways identified under current site conditions. As previously discussed, groundwater is not currently being used as a potable water source; however, the HHRA for Lines 5A/5B evaluated potential exposures to groundwater due to its potential future use as a drinking water source. This consists of evaluating future residential exposures to groundwater. Therefore, ingestion and dermal contact exposures to COPCs in groundwater were estimated for future site workers and hypothetical residents; inhalation exposures to site groundwater are incomplete because no volatile COPCs were identified in groundwater at Lines 5A/5B. Culverts are located at Lines 5A/5B; therefore, potential ingestion, dermal contact, and inhalation exposures to shallow groundwater in a trench were evaluated for future construction/utility workers. For Line 5B, however, no estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels, and COCs were not identified for a residential scenario. Therefore, site workers and construction/utility workers were not evaluated for Line 5B. The potential exposure pathways quantified in the HHRA are included in Appendix A-7, Attachment 1 (Table 1) and on Figure 5.6-6. The following receptor scenarios were quantified in the HHRA for Lines 5A and 5B:

- Future site worker.
  - Groundwater (tap water) COPCs—ingestion and dermal contact.
- Future construction/utility worker.
  - Shallow groundwater (trench, 0 to 10 feet bgs) COPCs—incidental ingestion and dermal contact.
- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion and dermal contact.

Risks and hazards for site workers and construction/utility workers were quantified in the Line 5A HHRA because the estimated risks or hazards for a hypothetical residential scenario exceeded acceptable risk or hazard levels and COCs were identified for a residential scenario.

The following receptor scenario was quantified in the HHRA for the Line 5B:

- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion and dermal contact.

In accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b), groundwater EPCs are typically calculated based on the data collected in the core of a plume. An RDX plume is present at both Line 5A and Line 5B (Figure 5.6-4).

At Line 5A, monitoring wells within the core of the RDX plume groundwater data set consist of two wells: 5A-MW2 and 5A-MW3. Monitoring wells within the core of the Line 5B RDX plume groundwater data set consist of two wells: 5B-MW1 and 5B-MW3. For COPCs at both Line 5A and Line 5B, the MDC was selected as the EPC because fewer than four detected concentrations were available in the groundwater dataset, and a reliable UCL could not be estimated due to the limited number of detected concentrations. The groundwater EPCs used to estimate the chemical daily intakes for each receptor scenario are provided in Appendix A-7, Attachment 1 (Table 3.1 and Table 3.2 [Line 5A plume] and Table 3.3 [Line 5B plume]).

The exposure factors used in the daily intake calculations for future receptor scenarios are included in Appendix A-7, Attachment 1 (Tables 4.2 and 4.2). The primary references for the exposure factor values are the standard default exposure factors presented in the HHEM *Update of Standard Default Exposure Factors* (USEPA, 2014a).

One COPC, chromium, which was evaluated as hexavalent chromium in the HHRA, was identified as acting with an MMOA for both Line 5A and Line 5B groundwater. The ADAFs and exposure assumptions used to calculate adjusted daily intakes for chromium are provided in Appendix A-7, Attachment 1 (Table 4 Supplement A).

5.6.6.4 Toxicity Assessment

The oral toxicity values (CSFs and RfDs) used in the HHRA were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as provided in Section 4.3.1. Noncancer toxicity values for the COPCs identified at Lines 5A/5B are provided in Appendix A-7, Attachment 1 (Table 5.1). Cancer toxicity values for the COPCs are provided in Appendix A-7, Attachment 1 (Table 6.1).

5.6.6.5 Risk Characterization

The risk characterization for Line 5A and Line 5B was completed using a four-step process, as discussed in Section 4.3.1. The results of each step are discussed below.

Step 1: Total Combined Risks and Hazards from Site-related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculating receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. The estimated risks and hazards for a hypothetical residential scenario are summarized in Table 5.6-16.

Table 5.6-16. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Lines 5A and 5B
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-7, Attachment 1	Exposure Medium	COPC/Chemical	Lines 5A and 5B		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.1 and 9.1	Groundwater (Tap water) Line 5A	2-amino-4,6-DNT	6.9	NA	2
			4-amino-2,6-DNT	43	NA	13
			RDX	6.5	NA	0.05
			Antimony	2.6	NA	0.2
			Cadmium	1.2	NA	0.08
			Chromium[c]	0.83	NA	0.01
			Manganese	60.8	NA	0.09
			Total HI (Groundwater):		**NA**	**16**
	7.4 and 9.4	Groundwater (Tap water) Line 5B	RDX	9.4	NA	0.07
			Antimony	2.8	NA	0.2
			Cadmium	0.55	NA	0.2
			Chromium [c]	4.9	NA	0.06
			Total HI (Groundwater):		**NA**	**0.5**
	Total HI (Groundwater—Tap Water)—Line 5A:				**NA**	**16**
	Total HI (Groundwater—Tap Water)—Line 5B:				**NA**	**0.5**

Table 5.6-16. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Lines 5A and 5B
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-7, Attachment 1	Exposure Medium	COPC/Chemical	Lines 5A and 5B		
				EPC [b]	**ELCR**	**HI**
Hypothetical Resident (Child)	7.2 and 9.2	Groundwater (Tap water) Line 5A	2-amino-4,6-DNT	6.9	NA	4
			4-amino-2,6-DNT	43	NA	22
			RDX	6.5	NA	0.08
			Antimony	2.6	NA	0.3
			Cadmium	1.2	NA	0.1
			Chromium[c]	0.83	NA	0.02
			Manganese	60.8	NA	0.1
			Total HI (Groundwater):		**NA**	**27**
	7.5 and 9.5	Groundwater (Tap water) Line 5B	RDX	9.4	NA	0.1
			Antimony	2.8	NA	0.4
			Cadmium	0.55	NA	NA
			Chromium [c]	4.9	NA	0.1
			Total HI (Groundwater):		**NA**	**0.9**
	Total HI (Groundwater—Tap Water)—Line 5A:				**NA**	**27**
	Total HI (Groundwater—Tap Water)—Line 5B:				**NA**	**0.9**
Hypothetical Resident Adult/Child Aggregate)	7.3 and 9.3	Groundwater (Tap water) Line 5A	2-amino-4,6-DNT	6.9	NA	NA
			4-amino-2,6-DNT	43	NA	NA
			RDX	6.5	7E-06	NA
			Antimony	2.6	NA	NA
			Cadmium	1.2	NA	NA
			Chromium[c]	0.83	2E-05	NA
			Manganese	60.8	NA	NA
			Total ELCR (Groundwater):		**3E-05**	**NA**
	7.6 and 9.6	Groundwater (Tap water) Line 5B	RDX	9.4	1E-05	NA
			Antimony	2.8	NA	NA
			Cadmium	0.55	NA	NA
			Chromium [c]	4.9	1E-04	NA

Table 5.6-16. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Lines 5A and 5B
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-7, Attachment 1	Exposure Medium	COPC/Chemical	Lines 5A and 5B		
				EPC [b]	ELCR	HI
			Total ELCR (Groundwater):		**1E-04**	**NA**
	Total ELCR (Groundwater—Tap Water)—Line 5A:				**3E-05**	**NA**
	Total ELCR (Groundwater—Tap Water)—Line 5B:				**1E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] Evaluated as hexavalent chromium

NA = not applicable

RME = reasonable maximum exposure

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculation of receptor-specific ELCRs and HIs for naturally occurring chemicals.

For Line 5A, thee COPCs (cadmium, chromium, and manganese) were identified as naturally occurring in site groundwater at Line 5A, as discussed in Section 5.6.4.2. The MDCs of cadmium, chromium, and manganese in groundwater were less than their respective BTVs.

For Line 5B, two COPCs (cadmium and chromium) were identified as naturally occurring in site groundwater at the Line 5B, as discussed in Section 5.6.4.2. The MDCs of cadmium and chromium in groundwater were less than the BTVs.

The estimated risks and hazards for the naturally occurring chemicals in groundwater for a future hypothetical residential scenario are provided in Table 5.6-17. The naturally occurring chemicals are not used to identify the final COCs for Lines 5A and 5B and are not discussed further in the HHRA after this step.

Table 5.6-17. Summary of Total Combined Risk and Hazard Estimates for Naturally Occurring Chemicals—Lines 5A and 5B
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-7, Attachment 1	Exposure Medium	Chemical	Lines 5A and 5B		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.7 and 9.7	Groundwater (Tap water) Line 5A	Cadmium	1.2	NA	0.08
			Chromium[c]	0.83	NA	0.01
			Manganese	60.8	NA	0.09
			Total HI (Groundwater):		**NA**	**0.4**
	7.10 and 9.10		Cadmium	0.55	NA	0.2
			Chromium [c]	4.9	NA	0.05

Table 5.6-17. Summary of Total Combined Risk and Hazard Estimates for Naturally Occurring Chemicals—Lines 5A and 5B

Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-7, Attachment 1	Exposure Medium	Chemical	Lines 5A and 5B		
				EPC [b]	ELCR	HI
		Groundwater (Tap water) Line 5B	**Total HI (Groundwater):**		**NA**	**0.2**
	Total HI (Groundwater—Tap Water)—Line 5A:				**NA**	**0.4**
	Total HI (Groundwater—Tap Water)—Line 5B:				**NA**	**0.2**
Hypothetical Resident (Child)	7.8 and 9.8	Groundwater (Tap water) Line 5A	Cadmium	1.2	NA	0.1
			Chromium[c]	0.83	NA	0.02
			Manganese	60.8	NA	0.1
			Total HI (Groundwater):		**NA**	**0.6**
	7.11 and 9.11	Groundwater (Tap water) Line 5B	Cadmium	0.55	NA	0.3
			Chromium [c]	4.9	NA	0.1
			Total HI (Groundwater):		**NA**	**0.4**
	Total HI (Groundwater—Tap Water)—Line 5A:				**NA**	**0.6**
	Total HI (Groundwater—Tap Water)—Line 5B:				**NA**	**0.4**
Hypothetical Resident Adult/Child Aggregate)	7.9 and 9.9	Groundwater (Tap water) Line 5A	Cadmium	1.2	NA	NA
			Chromium[c]	0.83	2E-05	NA
			Manganese	60.8	NA	NA
			Total ELCR (Groundwater):		**2E-05**	**NA**
	7.12 and 9.12	Groundwater (Tap water) Line 5B	Cadmium	0.55	NA	NA
			Chromium [c]	4.9	1E-04	NA
			Total ELCR (Groundwater):		**1E-04**	**NA**
	Total ELCR (Groundwater—Tap Water)—Line 5A:				**2E-05**	**NA**
	Total ELCR (Groundwater—Tap Water)—Line 5B:				**1E-04**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] Evaluated as hexavalent chromium

NA = not applicable

RME = reasonable maximum exposure

Step 3: Risk Characterization of Site-related COPCs

Step 3 consists of calculating receptor-specific ELCRs and HIs associated with site-related COPCs.

For Line 5A, four site-related COPCs (antimony, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX) were identified for groundwater. The estimated risks and hazards for COPCs in groundwater for a future hypothetical resident are provided in Table 5.6-18.

For Line 5B, two site-related COPCs (antimony and RDX) were identified for groundwater. The estimated risks and hazards for antimony and RDX in groundwater for a future hypothetical resident are provided in Table 5.6-18.

Table 5.6-18. Summary of Risk and Hazard Estimates for Site-Related COPCs— Lines 5A and 5B
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-7, Attachment 1	Exposure Medium	COPC	Lines 5A and 5B EPC [b]	ELCR	HI
Site Worker	7.13 and 9.13	Groundwater (Tap water) Line 5A	2-Amino-4,6-DNT	6.9	NA	0.6
			4-Amino-2,6-DNT	43	NA	4
			RDX	6.5	2E-06	0.01
			Antimony	2.6	NA	0.06
	Total ELCR and HI (Groundwater—Tap Water)—Line 5A:				**2E-06**	**4[c]**
Construction/Utility Worker	7.14 and 9.14	Shallow Groundwater (Trench) Line 5A	2-Amino-4,6-DNT	6.9	NA	0.01
			4-Amino-2,6-DNT	43	NA	0.09
			RDX	6.5	3E-10	0.00001
			Antimony	2.6	NA	0.002
	Total ELCR and HI (Groundwater—Tap Water)—Line 5A:				**3E-10**	**0.1**
Hypothetical Resident (Adult)	7.15 and 9.15	Groundwater (Tap water) Line 5A	2-Amino-4,6-DNT	6.9	NA	2
			4-Amino-2,6-DNT	43	NA	13
			RDX	6.5	NA	0.05
			Antimony	2.6	NA	0.2
			Total HI (Groundwater):		**NA**	**16[c]**
	7.18 and 9.18	Groundwater (Tap water) Line 5B	RDX	9.4	NA	0.07
			Antimony	2.8	NA	0.2
			Total HI (Groundwater):		**NA**	**0.3**
	Total HI (Groundwater—Tap Water)—Line 5A:				**NA**	**16[c]**
	Total HI (Groundwater—Tap Water)—Line 5B:				**NA**	**0.3**

Table 5.6-18. Summary of Risk and Hazard Estimates for Site-Related COPCs— Lines 5A and 5B
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-7, Attachment 1	Exposure Medium	COPC	Lines 5A and 5B EPC [b]	ELCR	HI
Hypothetical Resident (Child)	7.16 and 9.16	Groundwater (Tap water) Line 5A	2-Amino-4,6-DNT	6.9	NA	4
			4-Amino-2,6-DNT	43	NA	22
			RDX	6.5	NA	0.08
			Antimony	2.6	NA	0.3
			Total HI (Groundwater):		**NA**	**26[c]**
	7.19 and 9.19	Groundwater (Tap water) Line 5B	RDX	9.4	NA	0.1
			Antimony	2.8	NA	0.4
			Total HI (Groundwater):		**NA**	**0.5**
	Total HI (Groundwater—Tap Water)—Line 5A:				**NA**	**26[c]**
	Total HI (Groundwater—Tap Water)—Line 5B:				**NA**	**0.5**
Hypothetical Resident (Adult/Child Aggregate)	7.17 and 9.17	Groundwater (Tap water) Line 5A	2-Amino-4,6-DNT	6.9	NA	NA
			4-Amino-2,6-DNT	43	NA	NA
			RDX	6.5	7E-06	NA
			Antimony	2.6	NA	NA
			Total ELCR (Groundwater—Indoor Air):		**7E-06**	**NA**
	7.20 and 9.20	Groundwater (Tap water) Line 5B	RDX	9.4	1E-05	NA
			Antimony	2.8	NA	NA
			Total ELCR (Groundwater—Tap Water):		**1E-05**	**NA**
	Total ELCR (Groundwater—Tap Water)—Line 5A:				**7E-06**	**NA**
	Total ELCR (Groundwater—Tap Water)—Line 5B:				**1E-05**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—micrograms per liter.

[c] The HI for hepatic (due to 2-Amino-4,6-DNT and 4-Amino-2,6-DNT) exceeds 1—Appendix A-7, Attachment 1 (see Tables 9.13, 9.15, and 9.16).

NA = not applicable

RME = reasonable maximum exposure

Step 4: Final COC Determination

Line 5A

For Line 5A groundwater (potable use) by future hypothetical residents, the target organ–specific HIs exceeded USEPA's threshold of 1 due to the COPCs indicated in Table 5.6-19:

Table 5.6-19. COPCs Exceeding USEPA Target Thresholds—Future Hypothetical Residents
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1 × 10^{-4}
2-Amino-4,6-DNT 4-Amino-2,6-DNT	None

These chemicals were identified as COCs in groundwater for future hypothetical residents. Therefore, potential exposures and risks and hazards were also estimated for future site workers and construction/utility workers (summarized in Table 5.6-18).

For potable use of groundwater by future site workers, the target organ–specific HIs exceeded USEPA's threshold of 1 due to the COPCs indicated in Table 5.6-20:

Table 5.6-20. COPCs Exceeding USEPA Target Thresholds—Future Site Workers
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1 × 10^{-4}
2-Amino-4,6-DNT 4-Amino-2,6-DNT	None

For contact with shallow groundwater by future construction/utility workers, the cumulative ELCR and HIs were less than the USEPA's acceptable risk range of 1 × 10^{-6} to 1 × 10^{-4} and less than the acceptable HI of 1, respectively, and no COCs were identified for this receptor. In summary, the following COCs were identified for groundwater, as presented in Appendix A-7, Attachment 1 tables (Table 5.6-21):

Table 5.6-21. Final COCs identified for Groundwater at Line 5A
Iowa Army Ammunition Plant, Middletown, Iowa

COC	Site Workers (Table 10.1)	Hypothetical Residents (Tables 10.2 and 10.3)
2-Amino-4,6-DNT	X	X
4-Amino-2,6-DNT	X	X

Line 5B

For Line 5B groundwater (potable use) by future hypothetical residents, the cumulative ELCRs and HIs were less than the USEPA's acceptable risk range of 1 × 10^{-6} to 1 × 10^{-4} and less than the acceptable HI of 1, respectively. As such, no COCs were identified for groundwater at Line 5B; therefore, Line 5B qualifies for an NFA decision for groundwater based on the results of the HHRA.

5.6.6.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. The general uncertainties associated with the HHRAs for the sites in this RI report are provided in Section 4.3.1. This section provides additional site-specific uncertainties associated with the HHRA for Lines 5A/5B that are not included in Section 4.3.1.

Hazard estimates for 2-amino-4,6-DNT and 4-amino-2,6-DNT could be over- or underestimated because screening RfDs were used in the risk calculations. As stated in the PPRTV documents for 2-amino-4,6-DNT and 4-amino-2,6-DNT (USEPA, 2022a, 2022b),

> It is inappropriate to derive a subchronic or chronic provisional RfD for [2-amino-4,6-dinitrotoluene or 4-amino-2,6-dinitrotoluene]. However, information is available which, although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors…. Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of a supplemental screening toxicity value than for a value presented in the body of the assessment.

Chemicals that were 100 percent not detected in an exposure medium were not included in the COPC identification process; however, they were evaluated in a separate screening to determine whether elevated nondetected results were present in site media. The detailed analysis of the nondetected chemicals at Lines 5A/5B is provided in Appendix A-7, Attachment 3. In summary, six explosives (2,4-DNT, 2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, and nitrobenzene), three metals (arsenic, cobalt, and thallium) and 15 VOCs have DLs and/or RLs exceeding SLs at Line 5A. Line 5B had three explosives (2,6-DNT, 2-nitrotoluene and nitrobenzene), three metals (arsenic, cobalt, and thallium) and 15 VOCs with DLs and/or RLs exceeding SLs. although the RLs and DLs for these nondetect chemicals are greater than the SLs, based on the comparison to historically detected chemicals in groundwater at IAAAP, further consideration of nondetect chemicals does not appear warranted in the Lines 5A/5B HHRA.

5.6.6.7 Summary of HHRA

An HHRA was prepared for Lines 5A/5B to evaluate potential current and future health risks from exposure to chemicals in site groundwater. Lines 5A and 5B are currently inactive, and former buildings have been demolished. Additionally, the site is closed to recreational activities, and hunting is not permitted within the site boundary. There are no potential receptors or potentially complete exposure pathways identified for Lines 5A/5B under current site conditions.

The following potential future human receptors were identified in the HHRA for Lines 5A/5B:

- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Lines 5A/5B. If buildings are constructed onsite, future site workers could be exposed to indoor air (if volatiles are present and migrating from groundwater) in future buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within the Lines 5A/5B site.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on its potential future use as a drinking water source at Lines 5A/5B and could be exposed to indoor air (if volatiles are present and migrating from groundwater) in future buildings.

Potential exposures and risks and hazards to future site workers and construction/utility workers were estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk or hazard levels and COCs were identified for a residential scenario.

The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are as follows:

- Line 5A
  - Groundwater (potable):
    - Naturally occurring: cadmium, chromium, and manganese.

    - Site-related: antimony, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX.
  - Groundwater (vapor intrusion): None.
  - Groundwater (trench scenario):
    - Naturally occurring: cadmium, chromium, and manganese.
    - Site-related: antimony, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX.
- Line 5B
  - Groundwater (potable):
    - Naturally occurring: cadmium and chromium.
    - Site-related: antimony and RDX.
  - Groundwater (vapor intrusion): None.

The risk characterization for Lines 5A/5B was completed using a four-step process, as discussed in Section 4.3.1. Step 1 presents the total combined risks and hazards from site-related COPCs and naturally occurring chemicals, as summarized in Table 5.6-16. Step 2 presents the risks and hazards from naturally occurring chemicals, as summarized in Table 5.6-17. Step 3 presents the risks and hazards from site-related COPCs, as summarized in Table 5.6-18.

For Line 5A, unacceptable groundwater risks and hazards were identified for hypothetical residents, and 2-amino-4,6-DNT and 4-amino-2,6-DNT were identified as final COCs. Therefore, groundwater risks and hazards were also estimated for future site workers and construction/utility workers. 2-Amino-4,6-DNT and 4-amino-2,6-DNT were identified as groundwater COCs for future site workers, and no COCs were identified for future construction/utility workers.

In summary, the following COCs were identified for groundwater at Line 5A (Table 5.6-22):

Table 5.6-22. Final COCs for Line 5A Groundwater
Iowa Army Ammunition Plant, Middletown, Iowa

Future Site Worker	Future Construction/Utility Worker	Future Hypothetical Resident
2-amino-4,6-DNT 4-amino-2,6-DNT	None	2-amino-4,6-DNT 4-amino-2,6-DNT

For Line 5B, no unacceptable groundwater risks or hazards were identified in Step 3 for hypothetical residents. Therefore, in Step 4, no COCs were identified for groundwater at Line 5B, and Line 5B qualifies for an NFA decision for groundwater based on the results of the HHRA.

5.6.7 Ecological Risk Assessment

The ERA for groundwater at Lines 5A/5B is presented herein, beginning with Step 1 of the ERA process (to determine whether there are complete exposure pathways). Soil at Lines 5A/5B is already addressed under the remedy for OU-1. There are no perennial surface water features within the Lines 5A/5B boundary, so as a result there are no complete exposure pathways for sediment or surface water. A summary of the Line 5A/5B relationship with the Long Creek and Brush Creek watersheds is discussed in the watershed ERA (CH2M, 2022) and included in Appendix I.

Groundwater is present onsite, but ecological receptors are not exposed directly to groundwater; however, groundwater is a transport medium, and contaminated groundwater has the potential to migrate to and discharge to surface water bodies. Although there are ditches onsite for drainage purposes, these are not perennial waterbodies and they do not provide suitable habitat for ecological receptors. Furthermore, as previously noted, there is no connectivity between the ditch and groundwater. Given the lack of perennial surface water bodies on Lines 5A/5B, the groundwater-to-surface-water exposure pathway is incomplete. Because there are no complete exposure pathways for ecological receptors for Lines 5A/5B, no ecological adverse effects are likely. Therefore, no additional analyses from an ecological perspective are warranted.

5.6.8 Conclusions and Recommendations

An RI was conducted for Lines 5A and 5B to refine the nature and extent of contamination in groundwater from historical activities and assess for potential unacceptable risk to human health and the environment. Soil at these sites was addressed under the remedial action for OU-1 and is not covered under this RI for OU-6. There are no perennial surface water features within the Lines 5A/5B boundary. Analytical data available for groundwater at Lines 5A/5B include VOCs, SVOCs, and explosives. Of these, only explosives were identified as site-related chemicals of interest based on historical site operations and a comparison of concentration data to site characterization PALs (listed in Appendix F) and BTVs.

During the most recent groundwater monitoring event in 2018, only RDX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT exceeded their site characterization PALs. These compounds exceeded PALs at only one shallow overburden well (5A-MW2) and were either not detected or did not exceed PALs in shallow overburden monitoring wells surrounding 5A-MW2. Explosives were also not detected in newly installed shallow overburden well 5A-MW6, indicating that historical soil contamination near former Building 5A-29 did not impact groundwater. The explosives plume in groundwater at Line 5B is present only in the shallow overburden aquifer, and the lateral and vertical extents of contamination are limited.

An HHRA and an ERA were conducted to quantify potential risks to human health and the environment from exposure to contaminants at the Lines 5A/5B. The following conclusions were made based on the risk assessments:

- The HHRA identified potential unacceptable risks for receptors at Line 5A, including future site workers and construction/utility workers and future hypothetical residents exposed to groundwater. 2-amino-4,6-DNT and 4-amino-2,6-DNT were identified as groundwater COCs at Line 5A. For Line 5B, no unacceptable groundwater risks or hazards were identified for potential receptors, and no COCs were identified.
- The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Lines 5A/5B.

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs (2-amino-4,6-DNT and 4-amino-2,6-DNT) in groundwater at Lines 5A/5B. It is recommended that an FS be conducted under OU-6 to evaluate remedial alternatives to address the unacceptable risks in groundwater at Lines 5A/5B (IAAP-006G). When developing remedial alternatives, the FS should consider the reasonably foreseeable future land use for this area.

5.7 IAAP-044_Line 800 and Pinkwater Lagoon (19105.1048) and IAAP-044G_Line 800 and Pinkwater Lagoon Groundwater (19105.1049)

This subsection summarizes RI activities at the Line 800 Ammunition Renovation site (Line 800) and Pinkwater Lagoon. There are no other perennial surface water features within the Line 800 site boundary. Soil within the Line 800 site boundary falls under IAAP-011 and soil within the Pinkwater Lagoon site boundary falls under IAAP-044; site boundaries are shown on Figure 5.7-1. Soil within the Line 800 portion of the site (IAAP-011) is addressed under the remedy for OU-1 (Leidos, 2018). At Pinkwater Lagoon, an interim remedial action is in place for soil, sediment, and surface water within the former leaching pond (19105.1048, IAAP-044). The interim action does not address groundwater (19105.1049, IAAP-044G). Although the interim action for the former wastewater impoundment pond (19105.1048, IAAP-044) was referenced in the OU-1 ROD, it was not a component of the OU-1 remedy. This report administratively serves as an additional RI report under CERCLA for all media at the former wastewater impoundment in order to facilitate the future documentation of the interim action, and any groundwater remedy, under a ROD.

5.7.1 Background

5.7.1.1 Site Description

The Line 800 portion of the site encompasses approximately 18 acres in the central part of the IAAAP. The site includes over 20 former buildings and structures that are no longer present but whose former locations are encompassed by a security fence. Buildings were recently demolished as part of IAAAP's facility demolition plan (IAAAP, 2023). There are plans for a new Long Range Precision Artillery Product Facility at the site. The Pinkwater Lagoon portion of the site is an approximately 9-acre area adjacent to and northeast of Line 800 (Figure 5.7-1). The former buildings and lagoon are surrounded predominantly by grass-covered areas and small roadways.

Pinkwater Lagoon is a constructed feature that was originally built as a 5-acre leaching field to hold wastewater and sludges from various IAAAP locations prior to discharge to surface drainages leading to Brush Creek. The lagoon was surrounded by an earthen berm and was approximately 4 feet deep (JAYCOR, 1996). In 1996, the settling pond was removed. In 1998, Pinkwater Lagoon was converted to a constructed wetland treatment cell covering approximately 9 acres as part of an interim remedial action (ECC, 2001a).

Currently, Pinkwater Lagoon naturally collects stormwater runoff, which may or may not contain elevated levels of RDX (PARS-Gannett Fleming, 2021). The treatment system includes two lagoons (one small lagoon that feeds into a larger lagoon) that are connected by a culvert composed of two 6-inch PVC pipes to control the water level in the small lagoon; however, the system is collectively called the "lagoon" in this report. Surface water is detained in Pinkwater Lagoon throughout the year and is occasionally discharged in accordance with its O&M plan (Aerostar, 2016). The water is treated prior to discharge, if necessary, to ensure RDX concentrations are less than 2 µg/L. In 2018, a mobile treatment GAC unit was constructed for use at Line 800 when needed.

5.7.1.2 Operational History

Line 800

Line 800 has been in operation since its construction in 1941. From 1943 to 1955, the primary functions of the line were renovating medium- to major-caliber shells and bombs, recovering ammonium nitrate as liquor, recovering TNT for reprocessing, and reconditioning and repainting shells and bomb casings

(Tetra Tech, 2006b). The ammonium nitrate liquor was stored in noninsulated, aboveground storage tanks. Reportedly, the metals waste stream for the demilitarization operations was collected and sold as scrap (Tetra Tech, 2006b). Operations at the renovation plant were temporarily discontinued following the end of World War II, in 1945 (TN & Associates, 2003a).

In May 1946, operations continued with the renovation of shells, which included cleaning the outer shell casings (shot blasting) and applying the final paint. In September 1946, Line 800 was put on standby status. In June 1948, as part of a new renovation project, shells and bombs were steam washed to remove explosives and then physically cleaned by shot blasting. The bombs and shell casings were then painted and sent, unloaded, to a permanent storage. This project was completed in November 1948, and Line 800 was returned to standby status (TN & Associates, 2003a).

Line 800 operations were reinstated in 1951 and included renovation work on the M53A1. From 1951 to 1955, Line 800 continued discharging wastewater and dumping sludges onto the furrowed area (further discussed below). In January 1955, a small washout system was designed, built, and installed for washing out explosives. Processes for stripping paint and derusting, phosphatizing, and repainting 90-mm shot were established and implemented at this time. In June 1955, Line 800 was put into layaway status. All buildings and equipment were cleaned before shutting down (TN & Associates, 2003a).

Line 800 was put back into operation between August and December 1955. New equipment was added to renovate various munitions. Operations during the late 1950s and early 1960s are thought to have been on an as-needed basis until the beginning of the Vietnam War (TN & Associates, 2003a).

In 1968, an inert preassembly and inspections operation began in former Building 800-04. Mines, loaded at Line 9, were transferred to former Building 800-61 (Figure 5.7-1) to be assembled and packed. These mines were leak-checked and X-rayed in former Building 800-61 for quality assurance purposes. Of note is that liquid Freon was used to reduce the sensitivity of lead azide when loading, packing, and storing mines. The final assembly procedures were terminated in approximately May 1968. The shutdown continued through September 1968. Near the end of 1968, inert operations for the facility were performed at former Building 800-04 (TN & Associates, 2003a).

Groundwork for a water pollution abatement program for Line 800 began in 1970. Construction for the Pinkwater Treatment Plant (former Building 800-70-1) was initiated in 1972 and completed in June 1973. Also included in this program was a treatment system for chemical effluent from former Building 800-04, a paint-stripping/metal-cleaning facility. The practice included process cleaning and plating wastes through waste treatment systems where the flow was treated via pH adjustment and lime coagulation. Hexavalent chromium was treated with sulfite to reduce the chromium to the trivalent form (USATHAMA, 1980). Newer high-pressure equipment was installed to wash explosives out of projectiles in 1977. The high-pressure system for the shells washout was installed in former Building 800-191 (Figure 5.7-1) (TN & Associates, 2003a).

In 1980, the assembly of blank ammunition was the principal activity at Line 800. From 1983 to 1989, remote sawing of explosives items, remote core drilling, and remote disassembly of projectiles supported other IAAAP production lines (TN & Associates, 2003a). The line was used for the demilitarization of fuses. Reportedly, the metals waste stream was in a closed-loop system whereby metals were collected and sold as scrap (JAYCOR, 1996). The 2009 remedial action completion report for OU-1 (Tetra Tech, 2009a) noted that Line 800 was in modified caretaker status at the time of the soil remedial action. Line 800 is no longer in use since the remaining buildings were demolished as part of IAAAP's facility demolition plan (IAAAP, 2023).

Pinkwater Lagoon

The Pinkwater Lagoon was originally constructed in 1943 as a leaching field for wastewater. It received explosives wastewater and sludges from adjacent Line 800 production facilities and various locations at the IAAAP from 1943 to the 1970s, potentially including metal-cleaning sludge from Line 3 operations.

No known wastewater treatment processes were employed prior to wastewater being disposed of at the lagoon.

Wastewater was allowed to infiltrate into the leaching field and/or run off into a smaller collection pit, through which a diverted intermittent stream flowed. In 1944, the area was furrowed (into 20 furrowed rows) to increase evaporation and infiltration. A diked area was also added to the northern portion of the lagoon to better concentrate the flow into this smaller collection pit, which was used until 1945. Five settling basins or ponds were also located along the course of the intermittent drainage north of the diked area. Each basin contained an outlet pipe into an intermittent drainage way leading to Brush Creek. These sediment basins are thought to have been constructed after 1945 and used in the 1950s. Line 800 operations were reinstated in 1951 and continued discharging wastewater and dumping sludges onto the furrowed area from 1951 to 1955 (TN & Associates, 2003a).

In 1955, a bermed area was constructed around the furrowed area to create a 5-acre, 4-foot-deep lagoon. The berm is documented to have been 0.9 to 1.2 meters high (USATHAMA, 1980). An outfall structure was constructed on the northeastern side of the northern dike area, and an emergency spillway was built on the northwestern side. The northern collection pit area did not exist in 1965, and it is not known when this pit area was backfilled (TN & Associates, 2003a). The lagoon was used until 1970 as a settling pond to reduce particulates before wastewater was discharged to surface drainage to Brush Creek. In the early 1970s, a carbon filter system was installed to treat process water generated at the line before it reached the lagoon (JAYCOR, 1996). The settling pond was removed in 1996, though the berms were left in place. In 1997, Pinkwater Lagoon was remediated (ECC, 2001a).

5.7.2 Previous Investigations and Remedial Actions

Numerous investigations have been conducted at IAAAP since the 1980s. Table 5.7-1 summarizes the previous investigations and remedial actions conducted at Line 800 and Pinkwater Lagoon, including conclusions and recommendations. Although soil at Line 800 has already been addressed under OU-1, previous investigations for soil are also presented in Table 5.7-1 to support the CSM. Similarly, intermittent surface water and sediment samples collected at Line 800 are also included in Table 5.7-1 as they are part of the previous investigations in these areas.

This report summarizes the RI for soil at Pinkwater Lagoon (IAAP-044), groundwater at Line 800 and Pinkwater Lagoon (IAAP-044G), and surface water and sediment at the Pinkwater Lagoon (IAAP-044G). Previous investigations pertinent to the RI for these IAAAP sites are listed in Table 5.7-2; additional details on these investigations (including a more-detailed description of work completed as well as work not pertinent to this RI) are included in Table 5.7-1. Previous sample locations are shown on Figure 5.7-2.

Table 5.7-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Contamination Survey (ERG, 1982)	Sediment and surface water samples were collected from Pinkwater Lagoon, and groundwater samples were collected surrounding the lagoon. Samples were analyzed for explosives. Sediment, surface water, and groundwater had detected concentrations of one or more explosives (RDX, 1,3,5-TNB, TNT, 1,3-dinitrobenzene, and 2,6-DNT). Further delineation of detected explosives was recommended.

Table 5.7-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
Follow-on Study of Environmental Contamination (McKown et al., 1984)	Surface water and sediment samples were collected from within or northeast of Pinkwater Lagoon. Overburden and bedrock groundwater samples were also collected. All samples were analyzed for explosives and metals. Explosives and some metals were detected at elevated concentrations in soil/sediment, with greater concentrations present toward the southwestern end of the lagoon. Explosives were also detected in surface water and in groundwater at lesser concentrations. It was concluded that explosives in shallow groundwater was due either to leaching of contaminated sediments from the lagoon or to infiltration of much greater explosives concentrations that may have existed in the surface water of the lagoon in the past.
Midwest Site Confirmatory Study (Dames & Moore, 1986)	Groundwater and surface water samples were collected and analyzed for explosives, VOCs, and metals. Explosives were detected in shallow and deep groundwater at Line 800/Pinkwater Lagoon. Elevated levels of cadmium, copper, and lead were present in surface water.
Endangerment Assessment/FS, Line 1 Impoundment and Line 800 Pinkwater Lagoon (Dames & Moore, 1989a)	Soil samples within the Pinkwater Lagoon area and groundwater samples were collected and analyzed for explosives and metals. Elevated levels of explosives were present in overburden and bedrock groundwater, surface water, soil, and sediment. Elevated levels of cadmium, copper, and lead were also present in soil/sediment. Explosives and metals concentrations were generally greatest in soil and sediment in the southwestern portion of the lagoon where sludge was historically dumped. Explosives concentrations decreased with depth.
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	Releases of explosives to the environment may have occurred during historic site operations at Line 800 and resulting from wastes dumped at Line 800 before the Pinkwater Lagoon was constructed. Detailed sampling of soil and groundwater was recommended to investigate the effects of past spills and discharges to the surface and to assess whether contaminants from the Pinkwater Lagoon have migrated beneath Line 800.
Facility-wide Site Inspection (JAYCOR, 1992)	No groundwater samples were collected during the facility-wide site inspection from Line 800. It was recommended that Line 800 be included in the RI.
Phase I and Follow-on RI (JAYCOR, 1993a, 1996)	Soil samples were collected from settling ponds within the Pinkwater Lagoon area and from the lagoon and analyzed for VOCs, SVOCs, metals, and explosives. Groundwater samples were collected from Line 800 and Pinkwater Lagoon and analyzed for VOCs, SVOCs, explosives, and metals. Low levels of SVOCs were detected in two of the five settling ponds and in the three sample locations in the lagoon. Explosives were detected in all five settling ponds. In the lagoon, RDX was detected at a maximum concentration of 21.9 mg/kg; TNT was detected at a maximum concentration of 21.4 mg/kg; and HMX was reported at a maximum concentration of 23.8 mg/kg. Explosives were detected in groundwater, with a maximum RDX concentration of 13,000 µg/L reported in G-20, at the upgradient boundary of the lagoon. No metals were reported at a concentration greater than 10 µg/L and only low levels of VOCs were detected in Line 800. Elevated metals and VOCs were reported in wells within the Pinkwater Lagoon area.
Baseline Human Health and Ecological Risk Assessment, Former Line 1 Impoundment and Pinkwater Lagoon (JAYCOR, 1994b)	The 1989 Endangerment Assessment report was rewritten to incorporate USEPA comments on the original document and more current baseline risk assessment approaches. The revised risk assessment concluded that soil/sediment and groundwater at the Pinkwater Lagoon potentially posed risks in excess of 10^{-6}, with RDX and 2,6-DNT being the primary risk drivers.

Table 5.7-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Conclusion
SRI Line 800/Pinkwater Lagoon (MWH, 2001)	Groundwater samples were collected from 26 monitoring wells and analyzed for explosives and metals; select samples were also analyzed for VOCs. High concentrations of explosives, primarily RDX and TNT, were detected in groundwater around the lagoon. The lateral and vertical extent of the explosives plume was considered defined. VOC concentrations did not exceed SLs. Elevated levels of arsenic, chromium, and lead were detected in several wells during the 1999 sampling (where samples had high turbidity), but only lead exceeded the SLs during the subsequent 2000 sampling event. The SRI concluded that metals did not appear to be COCs at the Pinkwater Lagoon, but additional monitoring was recommended.
Periodic Groundwater and Surface Water Monitoring (multiple reports)	Groundwater samples were collected from Line 800 and Pinkwater Lagoon during multiple sampling events between 1998 and 2006. Samples were analyzed for VOCs, explosives, perchlorate, or metals, depending on the sampling event. VOCs, explosives, and metals were detected in groundwater samples collected from wells screened within the shallow zone of the overburden aquifer. The explosive RDX was also detected at a concentration greater than its screening level in the intermediate zone of the overburden aquifer.
Groundwater Flow and Contaminant Fate and Transport Modeling (URS, 2003b)	Groundwater flow and contaminant fate and transport modeling was conducted to support a groundwater FS. The modeling results indicated a no action alternative for groundwater contamination at Line 800 and Pinkwater Lagoon would result in the explosives plume discharging to the Brush Creek tributary at concentrations greater than the MCLs, or RSL/HAL if the MCL was not available.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	The work plan concluded that contaminants in soil and groundwater had been adequately characterized. There was uncertainty whether the Line 800 tributary was contributing to contamination at Brush Creek. It was recommended that an additional sampling point be added to the periodic monitoring program to assess this data gap.
Groundwater Treatability Study (Tetra Tech, 2009a, 2012b)	Two groundwater treatability studies (a small scale and a following full scale) were conducted at Line 800 to test the efficacy of enhanced in situ bioremediation at reducing the greatest concentrations of RDX to levels that could be further remediated using natural attenuation. Concentrations of RDX and TNT decreased during both studies. It was concluded that the addition of a carbon amendment enhanced the natural degradation process of explosives in groundwater across the site. By fall 2009, concentrations had largely decreased except in a few remaining hot spots, where they had increased or remained largely the same. Additional injections were recommended at Line 800.

Based on the results of previous investigations, several remedial actions have been implemented at Line 800 and the Pinkwater Lagoon (Table 5.7-1). In accordance with the OU-1 ROD (USAEC, 1998; Harza, 1998) and the Action Memorandum for Pinkwater Lagoon and the Line 1 Impoundment (CDM, 1996), soil removals have been conducted at Line 800, and soil/sediment removal has been conducted at the Pinkwater Lagoon. Excavation areas for Line 800 and the Pinkwater Lagoon are shown on Figure 5.7-1. Line 800 is also subject to OU-1 LUCs (Table 5.7-1) (Leidos, 2019).

As documented in the final CWWP (Tetra Tech, 2006b), explosives, primarily RDX and TNT, were the primary contaminants detected in soil at Line 800 and Pinkwater Lagoon. Explosives (RDX, TNT, and 2,4-DNT) and metals (arsenic, lead, and copper) were identified as soil COCs under OU-1 at Line 800 (Tetra Tech, 2009a). Prior to the soil removals, elevated concentrations for both explosives and metals were noted south of former Buildings 800-70-1 and 800-61. Elevated concentrations of TNT greater than OU-1 RGs were also found in soil samples west of Building 800-191 and southeast of 800-70-1. RDX was also reported in soils south of Building 800-192, west and south of Building 800-191, and southeast of Building 800-188. Lead exceedances were identified west of Building 800-191. An arsenic concentration greater than its OU-1 RG was noted in one location southeast of Building 800-61. There were multiple sample locations with elevated copper concentrations.

Figure 5.7-1 shows the areas where soil removal has occurred. Based on confirmation sampling, all soil with concentrations greater than OU-1 RGs was removed from the excavation areas with one exception. Of note, RDX and TNT soil RGs are based on leachability protection levels. To prevent compromising the soil underneath active railroad tracks to the north and integrity of the lagoon berm to the south, one of the soil excavations (L800-E08) north of the lagoon and south of the railroad tracks was stopped at 12 feet bgs. Verification samples showed TNT concentrations exceeding the OU-1 RG between 12 and 14 feet on the north wall of the excavation, between 14 and 18 feet on the south wall; and marginal RDX exceedances were found between 6 and 10 feet on the east wall (Tetra Tech, 2009a). However, TNT concentrations in the north wall and south wall were below the maximum construction worker exposure depth of 10 feet bgs and the ecological exposure depth of 1 foot bgs. Therefore, it was determined that allowing the residual TNT to remain in place below 12 feet bgs was protective of human health and the environment. The residual RDX concentrations in the east wall are overlain and underlain by soil containing RDX concentrations less than the OU-1 RG, suggesting that the potential for vertical leaching of low residual RDX through the dense clay underlying and surrounding L800-E08 is unlikely. Furthermore, high-fructose corn syrup was added to the excavation area while it was being backfilled to facilitate contaminant biodegradation. This excavation area is located adjacent to monitoring well 800-MW-6; explosive concentrations were observed to decrease in groundwater from this well following the soil remedial action. Because soil was remediated to its leachability goals for RDX and TNT (aside from the aforementioned exception), the sources to groundwater in the removal areas have been addressed.

Additional soil investigation was conducted at Line 800 in 2022 to determine if contaminated soil exists beneath recently demolished buildings and delineate the contamination in vadose zone soil that exceeds OU-1 RGs (TAC, 2022). The IAAAP is currently undergoing a modernization effort involving the demolition of numerous buildings throughout the Plant. The analytical results will be used to support future remedial design for soil contaminants under OU-1, and would be considered when developing the FS for OU-6, if a new soil source to groundwater was identified.

The soil/sediment removal at the Pinkwater Lagoon was implemented as part of an ongoing interim remedial action for the IAAP-044 site, which includes the following components: NTCRA for soil/ sediment, construction of a berm across the lagoon to separate the large and small pools, installation of outlet works to control discharges to the Brush Creek tributary, installation of a temporary GAC treatment system, construction of a 9-acre phytoremediation wetland and treatment system, and phytoremediation sampling. Details of the interim remedial action are provided in the final *Remedial Action Report, Multiple Removal Actions* (ECC, 2001a) and the final *Line 1 Impoundment and Line 800 Lagoon Operations and Maintenance Plan* (Aerostar, 2016). Interim remedial action components are summarized in the bullets below.

- An estimated 74,736 cubic yards of contaminated soil and sediment was excavated in 1997 (ECC, 2001a). RDX concentrations in several confirmation samples exceeded the OU-1 RG leaching remediation goal of 1.3 mg/kg; however, the Army and USEPA approved backfilling the excavations based on the low contaminant concentrations remaining, minimal human health and ecological risks, and presence of groundwater in the excavations. Concentrations of all other explosives were less than the removal goals. Note that unlike the soil removals within the Line 800 site boundary, the NTCRA was not part of the OU-1 final remedy, and the Pinkwater Lagoon was not included within the OU-1 LUC boundaries (Leidos, 2019).
- Following the NTCRA, an engineered treatment wetland was established. Phytoremediation sampling was conducted in 1998 and 1999.
- An overflow valve was constructed following the NTCRA and establishment of the wetland. The overflow valve regulates the large-pool surface water elevation to 678.7 feet amsl, below the action

discharge elevation of 679 feet amsl, which provides adequate storage for the surface runoff and direct precipitation from a 10-year, 24-hour rainfall event (4.9 inches). If the water level approaches the Line 800 Lagoon action discharge elevation, water is released to the small pool.

- A temporary GAC treatment system was installed in 1997, and treated water samples were collected to assess efficacy of the treatment system. The treatment system consisted of a 100-µg bag filter, a multimedia sand and gravel filter, and two GAC vessels, each containing 1,500 pounds of GAC. The temporary system was eventually removed and replaced in 2018 with a mobile GAC system for treatment. Water enters the treatment system through a submersible pump or a 3-inch siphon and discharges to a Brush Creek tributary (Aerostar, 2016).
- The interim treatment system was further optimized in fiscal year 2018. The siphon line used to drain the lagoon was permanently installed underground with a control valve built inside weatherproof housing. Revetment stone was placed at the outfall of the siphon line. An emergency overflow structure was also installed (PARS-Gannett Fleming, 2019).
- In accordance with O&M procedures (Aerostar, 2016), surface water is released from the Pinkwater Lagoon as a direct release or a mobile treatment system release. A direct release may occur when RDX concentrations are less than 2 µg/L and turbidity is less than 30 NTU. The treatment system is used when the elevation of the impoundment exceeds the action discharge elevation of 679 feet amsl and RDX concentrations within the impoundment are greater than 2 µg/L. Prerelease sampling is conducted to determine the type of release, and postdischarge and treatment system sampling are conducted to confirm discharge concentrations and treatment effectiveness. The last reported release was performed from August through October 2019 and was direct to Brush Creek (PARS-Gannett Fleming, 2021).
- O&M activities are conducted on a weekly to annual basis to sustain the proper functionality of the interim remedial action and maintain the surface water elevation at or below the action discharge elevation of 679 feet amsl. O&M activities and procedures include water-level monitoring; prerelease procedures; direct release procedures; treatment system release procedures; notification requirements; waste characterization and disposal; monitoring and maintenance of discharge structures, the siphon line, embankments, and signs; rock surfacing; vegetation control; slope repair; and control of burrowing animals (Aerostar, 2016). O&M activities and analytical sampling results are documented in annual O&M reports and are not part of this RI.

5.7.3 2018–2020 Remedial Investigation Activities

Additional field work was conducted at Line 800 and Pinkwater Lagoon to resolve data gaps needed to complete the RI for groundwater (IAAP-044G). As documented in the final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 1)* (CH2M, 2017b), RDX in groundwater was not adequately characterized at the sites. To address this data gap, five permanent overburden monitoring wells (800-MW27 and 800-MW31) were installed throughout the area (Figure 5.7-2). The five new monitoring wells and 26 existing monitoring wells were sampled for explosives. Fieldwork completed at Line 800 and Pinkwater Lagoon was conducted in accordance with the UFP-QAPP (CH2M, 2017b). No further investigation was warranted for soil, surface water, or sediment in the lagoon, as these media have been remediated or adequately characterized in previous investigations.

Between June 24 and July 9, 2018, five new overburden monitoring wells (800-MW27 through 800-MW31) were drilled and installed at Line 800 and Pinkwater Lagoon. Four monitoring wells were installed to characterize groundwater near historical soil removal areas, and one monitoring well was installed to characterize groundwater south of Pinkwater Lagoon, as follows:

- 800-MW27 was installed downgradient of a historical soil removal area northeast of former Building 800-08.
- 800-MW28 was installed between former Buildings 800-03-2 and 800-04, near a historical soil removal area.
- 800-MW29 was installed near the southeast corner of former Building 800-61, downgradient of a historical soil removal area.
- 800-MW30 was installed downgradient of former Building 800-188 and a historical soil removal area.
- 800-MW31 was installed south of Pinkwater Lagoon.

Monitoring well locations were drilled to 20 feet bgs using a combined DPT/I drill rig (Table 5.7-3). At each boring, continuous soil samples were collected to depth and logged for lithologic characterization. Boring logs are provided in Appendix C. Following initial sampling, boreholes were reamed with 8-inch-outer-diameter augers to the identified well depth. Each monitoring well was completed with a 2-inch-nominal-diameter Schedule 40 PVC screen and riser. Monitoring wells were screened from 10 to 20 feet bgs. The wells were constructed with a certified-clean 20/40 silica sand filter pack from the base of the borehole to 1–2 feet above the top of the screen. A bentonite seal (3 to 5 feet thick) was placed above the filter pack sand and hydrated. A cement grout was placed above the bentonite seal, and wells were completed with either flush-mounted or aboveground (stick-up) monuments with a locking steel well vault. Three bollards were installed around each well pad. Well completion diagrams are provided in Appendix C. Table 5.7-3 summarizes the monitoring well construction details for the new monitoring wells.

Newly installed monitoring wells were developed between June 26 and July 11, 2018. Monitoring wells were developed through a series of surging and pumping. At least one set of groundwater quality parameters (pH, temperature, turbidity, and specific conductivity) were collected during development. Due to low recharge rates, 800-MW27, 800-MW28, and 800-MW31 were developed until they ran dry and allowed to recharge before developing until dry again. Monitoring wells 800-MW29 and 800-MW30 were developed until the water was clear. Well development logs are included in Appendix C.

Monitoring wells were then sampled with the following data objective: Groundwater samples were collected from the 5 new wells and 26 existing monitoring wells to assess current explosives concentrations at Line 800 and Pinkwater Lagoon.

Twenty-six existing monitoring wells (800-MW-1, 800-MW-4, 800-MW-7 through 800-MW-9, 800-MW-12 through 800-MW-15, 800-MW-18, 800-MW-20, 800-MW25, 800-MW26, G-17, G-20, G-40, G-43, G-45, G-47, G-56, G-58, L800-TT-MW01, L800-TT-MW04, L800-TT-MW09, L800-TT-MW15, and L800-TT-MW18) and the five new monitoring wells (800-MW27 through 800-MW31) were sampled via low-flow purging and sampling techniques (with a peristaltic pump) between August 18, 2018, and August 29, 2018. Two existing monitoring wells (G-40 and G-47) were sampled on May 31, 2018, and April 24, 2018. Prior to sampling being initiated in August 2018, a sitewide water-level survey was completed (Table 5.7-4). Groundwater samples were shipped to an offsite laboratory for analysis of explosives by Method SW8330A. Purge logs are included in Appendix C. Data were managed and validated as discussed in Section 3.3. Laboratory reports are provided in Appendix B.

All IDW generated during activities (soil and purge water) was disposed of in accordance with management activities discussed in Section 3.2.9. Waste management documentation is provided in Appendix D.

In 2018, newly installed monitoring wells were surveyed by Bruner, Cooper, and Zuck, Inc., licensed Iowa surveyors in accordance with Section 3.2.8. In 2019, 20 existing monitoring wells (L800-TT-MW01 through L800-TT-MW18, L800-TT-MW19R, and 800) were resurveyed since top-of-casing elevation data were not available for these wells. Survey information is included in Appendix E.

5.7.4 Environmental Setting

5.7.4.1 Topography and Surface Water

The topography at Line 800 and Pinkwater Lagoon is generally flat with gentle slopes to the southeast and southwest. A topographic divide exists at the site. As a result, Pinkwater Lagoon and majority of Line 800 are in the Brush Creek watershed, but the southwestern corner of Line 800 is in the Long Creek watershed (Figure 5.7-2 inset).

Surface drainage on the Brush Creek watershed portion of Line 800 flows through drainage ditches and culverts and eventually converges at the headwaters of a tributary to Brush Creek (called the Line 800 tributary for reference purposes). Surface drainage near Pinkwater Lagoon is generally toward a tributary north of Pinkwater Lagoon, though some surface drainage may also flow to the southeast (Tetra Tech, 2006b). As previously discussed, a secondary, small pool and overflow valve structures are in place to maintain the water level in the lagoon (ECC, 2001a; Aerostar, 2016). Controlled discharges from the lagoon to the Brush Creek tributary north of the lagoon are also used to control water levels.

5.7.4.2 Geology and Hydrogeology

Geology

At Line 800 and Pinkwater Lagoon, the overburden (fill, loess, and till) is composed of a heterogeneous mix of clay and lean clay with interbedded, discontinuous sand and silty sand lenses. The unconsolidated overburden is underlain by bedrock, which is encountered at depths ranging from 41 to 55 feet bgs. The bedrock is composed of limestone with interbedded shale. A cross section is provided in Figure 5.7-3.

Hydrogeology

Groundwater in the overburden occurs at depths ranging from less than 1 foot bgs to approximately 22 feet bgs and is under generally unconfined conditions. In the bedrock, groundwater occurs at depths ranging from approximately 2.5 feet bgs to 32 feet bgs. During the 2018 RI field activities, overburden water levels ranged from 7.23 to 32.98 feet bgs, and bedrock water levels ranged from 10.94 to 65.70 feet bgs (Table 5.7-4). Figure 5.7-4 presents the August 2018 potentiometric surface map at the sites. There is a groundwater divide beneath the site related to its location along the watershed divide. Because of the groundwater divide and the influence of the constructed wetland at Pinkwater Lagoon and the northern tributary, groundwater flows to the southwest in the western portion of the site and to the northeast, east, and southeast in the eastern portion of the site (Figure 5.7-4).

Hydraulic conductivity (*K*) values calculated from slug testing range from 0.0077 ft/day to 4.3 ft/day in the overburden, with lesser *K* values in the bedrock (0.0032 to 0.1 ft/day). Infrequent groundwater–surface water interaction is suggested by the stream bed elevation in the upstream portion of the Line 800 tributary (672 feet amsl), and groundwater elevations in well 800-MW-5 (which has reported groundwater elevations up to 676 feet amsl) and well 800-MW-6 (which has reported groundwater elevations up to 676 feet amsl), located along the tributary branch.

Horizontal gradients in the overburden measured in August 2018 ranged between 0.008 ft/ft between 800-MW12 and 800-MW13 and 0.02 ft/ft between 800-MW-25 and G-43. At bedrock/overburden well pairs G-40/G-41, G-44/G-45, and G46/G-47, a downward vertical gradient is noted (Figure 5.7-4).

5.7.5 Nature and Extent of Contamination

This subsection describes the nature and extent of groundwater contamination at Line 800 and of surface water, sediment, and groundwater at the Pinkwater Lagoon. Soil at these sites is being addressed under OU-1. No perennial surface water or sediment is present at Line 800. Soil, surface water, and sediment in the pond at the Pinkwater Lagoon have been addressed via the interim remedial action.

Potential sources of contamination at Line 800 include historical releases of explosive compounds associated with ammunition production. The primary explosive compounds historically used at Line 800 included TNT, RDX, Composition B, black powder, HMX, and pentaerythritol. Primary release points/mechanisms include former wastewater sumps, melt buildings, and screening buildings. Active discharges at Line 800 ceased in 1997. Potential sources of contamination at the Line 800 Pinkwater Lagoon include explosives-contaminated effluent and metals-contaminated sludge disposed of in the lagoon while it was in use as a settling pond to reduce particulates before being discharged to surface drainage to Brush Creek, and subsequent historical leaching through soil and sediment at the bottom of the pond.

5.7.5.1 Soil and Surface Water/Sediment (within Pinkwater Lagoon)

Soil, sediment, and surface water within the Line 800 Pinkwater Lagoon have been addressed under an interim remedial action (ECC, 2001a). The following summarizes historical site contamination to support the CSM for the site.

At the Line 800 Pinkwater Lagoon, elevated levels of explosives were identified in sediment and surface water prior to the 1997 remedial actions. Concentrations of 1,3,5-TNB, TNT, HMX, and RDX as great as 134 mg/kg, 33,700 mg/kg, 860 mg/kg, and 2,900 mg/kg, respectively, were reported (CDM, 1996). In surface water, concentrations of TNT, HMX, RDX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT as high as 0.55 µg/L, 41.84 µg/L, 6.03 µg/L, 1.78 µg/L, and 3.34 µg/L, respectively, were reported (CDM, 1996); these surface water concentrations were less than their respective site characterization PALs. The southwest portion of the lagoon, coincident with the general location of an assumed former sludge and explosives-contaminated effluent dumping area, exhibited the greatest explosives concentrations (Battelle, 1984). Elevated explosives concentrations were predominantly present in the upper 2 feet of lagoon sediments, with concentrations decreasing with depth (CDM, 1996). As stated in the UFP-QAPP (CH2M, 2017a), "Older data (i.e., data collected prior to 2012) may be used in the human health risk assessments if they are still representative of the site (i.e., groundwater flow is slow), chemicals have properties where there would not be a significant reduction in concentrations over time (e.g., metals), or data are conservative for site conditions." Line 800 and Pinkwater Lagoon are no longer operational, as described in Section 5.7.1. Due to a lack of continuing sources, historical concentrations in sediment and surface water are expected to have remained stable or even decreased due to natural attenuation processes. Therefore, the assumptions in the final UFP-QAPP still hold. Samples collected prior to 2012 are considered representative of, or more conservative than, current conditions at Line 800 and Pinkwater Lagoon.

Explosives and metals were identified as contaminants of concern for soil and sediment at the Line 800 Pinkwater Lagoon in the revised draft final *Baseline Human Health and Ecological Risk Assessment, Former Line 1 Impoundment and Pink Water Lagoon* (JAYCOR, 1994b). Preliminary COCs included RDX, HMX, tetryl, 1,3-dinitobenzene, 2,4-DNT, 2,6-DNT, 1,3,5-TNB, TNT, cadmium, copper, and lead. Afterwards, the action memorandum (CDM, 1996) identified the following COCs for the Line 1 Impoundment and Pinkwater Lagoon: HMX, RDX, TNT, 1,3,5-TNB, 1,3-dinitrobenzene, nitrobenzene, DNTs, nitrotoluene, and tetryl. As discussed in Section 5.7.2, an NTCRA conducted in 1997 removed explosives-contaminated soil and sediment to meet removal action goals, which were based on risk-based industrial soil criteria and leachability criteria (for RDX and TNT). At the time of the removal action, surface water had collected in the lagoon. The accumulated water was treated using a GAC treatment system and discharged prior to initiating the excavation. Verification samples indicated some RDX concentrations exceeded the OU-1 RG leaching remediation goal of 1.3 mg/kg; however, the Army and USEPA approved backfilling the excavations based on the low contaminant concentrations remaining, minimal human health and ecological risks, and presence of groundwater in the excavations (ECC, 2001a). Photos of the area prior to and following the removal action are included on Figure 5.7-5.

In October 1998, following the 1997 removal, explosives were detected in 10 of 17 samples collected in sediment at the former impoundment pond during a phytoremediation study, with TNT having the greatest concentrations and a maximum concentration of 17 mg/kg, less than the OU-1 RG of 47.6 mg/kg.

Between 1999 and 2001, surface water samples were collected from the lagoon to monitor the success of treating explosives-contaminated groundwater using wetland plant species (URS, 2003c). The concentration data indicated successful reduction of explosives concentrations to nondetect levels in the surface water of the lagoon during the summer months. During the winter months, the RDX concentrations rose, but generally to levels less than 10 µg/L. Table 5.7-5 presents the concentrations of chemicals detected in the 2001 surface water samples.

O&M activities continue to optimize the interim remedial action and control discharge concentrations from the lagoon. As part of O&M activities for the interim remedial action, surface water samples are collected prior to surface water discharge to the Brush Creek tributary north of the lagoon. If RDX concentrations exceed 2 µg/L, they are treated with GAC prior to discharge to reduce concentrations to an acceptable level. Analytical sample data is provided in annual O&M reports (PARS-Gannett Fleming, 2021).

5.7.5.2 Groundwater

Groundwater samples have been collected from monitoring wells at Line 800 and Pinkwater Lagoon as part of several investigations between 1981 and 2018. Sixty-six monitoring wells are present at Line 800 and Pinkwater Lagoon. Fifty-one of the wells are screened in the overburden to depths ranging from 6.4 to 42.1 feet bgs, one is screened across the overburden–bedrock interface at a depth of 65 feet bgs, and 14 are screened in bedrock at depths ranging from 64 to 83.25 feet bgs. Historical groundwater samples were analyzed for VOCs, SVOCs, PAHs, explosives, metals, PCBs, pesticides, and herbicides. No herbicides, pesticides, PAHs, or PCBs were detected in historical groundwater samples. Based on historical site operations and COCs identified in soil, explosives, Freon, and metals are considered chemicals of interest in groundwater at Line 800 and Pinkwater Lagoon. While VOCs and SVOCs were detected, they did not exceed the PAL and so were not retained as chemicals of interest, except for Freon 113.

During the current RI, groundwater samples were collected at Line 800 and Pinkwater Lagoon from 30 monitoring wells and analyzed for explosives (Figure 5.7-6). Table 5.7-6 presents the concentrations of chemicals detected in groundwater samples since 2000. Statistical summary tables of the analytical results used in the HHRA are included in Section 5.7.7. Summary tables of all the analytical results (including nondetects) from the 2018 RI activities are provided in Appendix G. Summary tables of all historical analytical results from Line 800 and Pinkwater Lagoon are provided in Appendix H.

VOCs

Fourteen VOCs (1,1,1-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCA, 1,2-DCE, 2-hexanone, cis-1,2-DCE, Freon 113, methane, methyl isobutyl ketone, PCE, tetrahydrofuran, toluene, and TCE) were detected in previous groundwater samples collected from monitoring wells between 2000 and 2009 (Table 5.7-6). During the most recent monitoring event conducted at each sampling location, only 1,2-DCA was detected at a concentration greater than its site characterization PAL. 1,2-DCA slightly exceeded its site characterization PAL of 6 µg/L at monitoring well G-20, with a concentration of 6.2 µg/L in November 2004.

SVOCs

One SVOC, 1,4-oxathiane, was detected in previous groundwater samples collected from monitoring wells between 2000 and 2009 (Table 5.7-6). No SVOCs were detected at concentrations greater than their site characterization PALs.

Explosives

Between 2000 and 2018, 17 explosives were detected in groundwater at Line 800 and Pinkwater Lagoon (Table 5.7-6). Of these, 13 explosives were detected at concentrations greater than their site characterization PALs (1,3,5-TNB, 1,3-DNB, TNT, 2,4-DNT, 2-6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, HMX, nitrobenzene, and RDX). Nevertheless, explosives 2-nitrotoluene, 4-nitrotoluene, and HMX were less than their site characterization PALs in the most recent samples collected at each sample location.

Explosives contamination in groundwater is present as a large, shallow plume that extends from the southeastern portion of Line 800 and runs beneath the Pinkwater Lagoon. RDX exceeds the site characterization PAL most frequently and defines the extent of the plume as shown on Figure 5.7-6. Although other explosives exceeded the site characterization PALs, as noted above, the extent of these exceedances is captured within the RDX plume. During the current 2018 RI monitoring event, the greatest RDX concentration was reported at shallow overburden monitoring G-20 (6,500 J µg/L). The greatest concentration of TNT, which historically has been detected at concentrations greater than RDX, was also reported at G-20 (12 J µg/L). Monitoring well G-20 is at the southwest edge of the lagoon. Note that before the 2018 monitoring event, the greatest TNT concentration was reported at shallow monitoring well 800-MW-5 (27,000 µg/L in 2004); this well has since been abandoned. Shallow zone monitoring well L800-TT-MW19R was installed at the location of former well 800-MW-5; TNT was not detected in this well when it was sampled in 2008. Other explosives where concentrations have exceeded 1,000 µg/L between 2000 and 2018 include HMX, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and 1,3,5-TNB. The greatest concentrations of these chemicals have also been reported at monitoring well 800-MW-5 (HMX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) and monitoring well G-20 (1,3,5-TNB).

The plume is horizontally delineated to the west (G-40), east (G-43 and G-45), north (800-MW-12, 800-MW-8, 800-MW-20, and G-56), and south (L800-TTMW-01, L800-TTMW-04, 800-MW-18, G-47, and 800-MW-15) by new and existing wells. The plume is vertically delineated by bedrock monitoring wells 800-MW-2, 800-MW-3, 800-MW-4, and 800-MW-22, which are located throughout the plume; explosives were not detected at concentrations greater than their site characterization PALs in the most recent sampling conducted at these wells.

Metals

Between 2000 and 2009, 14 total metals were detected at Line 800 and the Pinkwater Lagoon (Table 5.7-6). However, only arsenic, barium, chromium, iron, lead, and manganese were detected at concentrations greater than their respective site characterization PALs and BTVs in groundwater, and of these, only iron and manganese exceeded their respective site characterization PALs and BTVs in 2009, the last sampling event that those chemicals were analyzed (Figure 5.7-7). Arsenic, barium, chromium, and lead generally were detected at concentrations greater than their respective site characterization PALs and BTVs in an early sample, but have been less than their respective characterization PALs and BTVs in several more recent samples.

These elevated concentrations of iron and manganese are not considered to be site related and are attributed to the enhanced reducing conditions created by the treatability study at Line 800 (Tetra Tech, 2009a, 2012b). As described in Table 5.7-1, high-fructose corn syrup was injected in the subsurface to assess the potential for enhanced bioremediation of RDX in groundwater over three injection events. Analysis of iron and manganese were included in the 2005 through 2009 performance monitoring events for monitoring wells located within the treatability study boundary to help evaluate whether reducing conditions were being established. Both iron and manganese exceeded their respective site characterization PALs and BTVs in the most recent samples collected at monitoring wells G-56, G-57, L800-TT-MW02, L800-TT-MW-03, L800-TT-MW-09, L800-TT-MW-15, L800-TT-MW-16, and L800-TT-MW-18. Manganese also exceeded its site characterization PAL and BTV in the last sample analyzed at L800-TT-MW05, L800-TT-MW11, L800-TT-MW-19R, L800-TTPZ-20, L800-TTPZ-21, L800-TTPZ-25R, and L800-TTPZ-26 (Figure 5.7-7). The maximum concentration of manganese (32,600 µg/L) was reported at G-56, compared to the site characterization PAL of 430 µg/L and BTV of 579.7 µg/L. The maximum concentration of iron (380,000 µg/L) was reported at G-57, compared to the site characterization PAL of 14,000 µg/L and BTV of 9,736 µg/L.

Concentrations of some metals may be naturally elevated in the environment, and may not indicate a CERCLA-regulated release. Several metals (such as arsenic, cadmium, and chromium) were detected at Line 800 and Pinkwater Lagoon at concentrations less than their BTVs during the more recent sampling events and are therefore considered to be consistent with background and naturally occurring now. Although cobalt does not have a BTV, its presence in groundwater is also not considered to be site related. During the last sampling event that cobalt was analyzed for (2004), it was reported in only one monitoring well, 800-MW-5, at a concentration of 4.4 B µg/L (Appendix H).This B qualifier indicates that cobalt was also detected in the associated method and/or calibration blank, so this monitoring well concentration is likely biased high. There is no reported use of cobalt at Line 800. As discussed above, elevated concentrations of manganese and iron are attributed to enhanced reducing conditions created by the treatability study.

5.7.6 Fate and Transport

This section discusses the fate and transport of site-related chemicals of interest at Line 800 and Pinkwater Lagoon. This includes chemicals that were detected at concentrations greater than both their site characterization PAL and BTV (if available). In groundwater, potential site-related chemicals of interest include explosives (1,3,5-TNB, 1,3-DNB, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, HMX, nitrobenzene, and RDX), Freon 113, and 1,2-DCA, based on 2000–2018 monitoring data. Fate and transport characteristics for these chemicals are described in Section 4.2.

Line 800 consists of former building footprints, roads, railroad tracks, and drainage ditches, which are surrounded by grass-covered areas. Pinkwater Lagoon currently consists of a treatment wetland and two lagoon ponds that are surrounded by a grassy berm and other vegetation. Due to a topographic divide at the site, wherein the ground surface slopes gently to the southeast (near the lagoon) and to the southwest (near the western side of Line 800), Line 800 and Pinkwater Lagoon falls within both the Long Creek Watershed and the Brush Creek Watershed (Figure 5.7-1). During periods of dry weather conditions, standing water in the pond may be minimal. Surface water in the pond is subject to controlled discharge to the Brush Creek tributary north of the lagoon. There are no buildings or permanent structures within the site boundary.

Contaminants have entered groundwater at Line 800 due to the historical discharge of process water from former buildings and sumps and/or clarifiers and the subsequent leaching of chemicals through unsaturated zone soil. The groundwater table at Line 800 and Pinkwater Lagoon is shallow, and groundwater in the overburden aquifer has been encountered between 7 and 23 feet bgs, with an average of 11 feet bgs, during the current 2018 RI (Table 5.7-4).

Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Groundwater flows to the southwest in the western portion of the site and to the northeast, east, and southeast in the eastern portion of the site (Figure 5.7-4). The overburden aquifer in this area is composed predominantly of silty and sandy clay and silt, with slug test calculated K values ranging from 0.0077 ft/day to 4.3 ft/day. Although a downward vertical gradient is evident at well pairs throughout the site, the lack of elevated contaminant concentrations in bedrock groundwater samples indicates vertical migration at the site is limited by the generally tight clay lithology in the overburden.

Natural attenuation mechanisms that are potentially active at Line 800 and Pinkwater Lagoon were evaluated. Natural attenuation includes various physical, chemical, or biological processes that under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. A weight-of-evidence approach was used for this evaluation.

- The primary line of evidence that attenuation is occurring at a site is reduction over time in contaminant concentrations or mass or both. To assess natural attenuation for explosives at Line 800 and Pinkwater Lagoon, concentration trends for the most extensive (RDX) and greatest-concentration (TNT) explosives were plotted for the monitoring wells where the maximum concentrations of these chemicals were reported (G-20 and 800-MW-5/L800-TT-MW19R, respectively). Concentration trends for other explosives where concentrations have exceeded 1,000 µg/L between 2000 and 2018 (HMX, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and 1,3,5-TNB) were also plotted for monitoring wells G-20 and 800-MW-5/L800-TT-MW19R, which similarly had the greatest concentrations of these explosives. Finally, RDX concentration trends were plotted for three other wells where RDX concentrations exceeded 100 µg/L in 2018 (G-58, 800-MW-25, and L800-TT-MW-09) (Figures 5.7-7 through 5.7-13).
- The trend chart for G-20 shows RDX concentrations have fluctuated with an overall decreasing trend. Other explosives (TNT, HMX, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and 1,3,5-TNB) have also exhibited an overall decreasing trend, with a stronger trend evident following the 1997 removal action at the lagoon. Similarly, RDX concentrations at G-58 and 800-MW-25 show strong decreasing trends over time, although L800-TT-MW-09 exhibits fluctuating concentrations that neither increase nor decrease overall. At 800-MW-5, the TNT and RDX concentrations generally increased from 1998 to 2001, after which they generally decreased through the last sampling event in 2004. Concentrations of TNT and RDX in replacement well L800-TT-MW19R continued to decline and were less than the site characterization PALs during the most recent sampling event in 2008. Concentrations of other explosives (HMX, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and 1,3,5-TNB) fluctuated between 1998 and 2001 at 800-MW-5, and decreased to less than site characterization PALs in replacement well L800-TT-MW19R. Overall, concentration trend data provide supporting evidence for natural attenuation or enhanced biodegradation due to the treatability study at Line 800 and Pinkwater Lagoon (i.e., at G-20, G-58, and 800-MW-25).
- Anaerobic daughter products of RDX (MNX, TNX, and DNX) were detected at most wells with RDX detections. The greatest concentrations were observed at monitoring well L800-TT-MW09, where the second greatest RDX concentrations were detected (630 µg/L); MNX, TNX, and DNX concentrations at this well were 43 J µg/L, 110 J µg/L, and 36 J µg/L, respectively, in 2018. At G-20, where the greatest RDX concentrations have been reported, MNX, TNX, and DNX concentrations were 19 J µg/L, 48 J µg/L, and 18 J µg/L, respectively. The presence of MNX, TNX, and DNX provides evidence that anaerobic biodegradation of RDX has occurred in groundwater at Line 800 and Pinkwater Lagoon.
- The amino-DNT isomers in groundwater may be byproducts of TNT reduction. Both 2-amino-4,6-DNT and 4-amino-2,6-DNT are common intermediates of TNT biotransformation, while 4-amino-2,6-DNT is also an abiotic degradation product of TNT (Battelle, 2015).
- Water quality parameters can be used to evaluate whether the geochemical conditions are conducive to biodegradation. During the current RI, overburden groundwater was observed to be under a range of aerobic to mildly anaerobic conditions, with DO concentrations ranging from 0.07 mg/L to 9.45 mg/L and an average DO concentration of 1.71 mg/L (Table 5.7-7). ORP values ranged from reducing (-199.1 mV) to oxidizing (231.8 mV), with an average of 82 mV. While ORP values in

some wells (such as G-40 and L800-TT-MW18) were indicative of reducing conditions, the majority of ORP reading were more indicative of oxidizing conditions. Geochemical conditions at G-20, where the greatest RDX concentrations have been reported, were moderately anaerobic and reducing with a DO of 0.43 mg/L and an ORP of -12.8 mV.

- Nitrite, sulfide, and methane concentrations were observed in several groundwater samples collected at Line 800 and the Pinkwater Lagoon (Appendix H), including at G-20 and 800-MW-5, where the greatest explosive concentrations have been reported. At G-20, nitrite, sulfide, and methane were reported at concentrations up to 2,800 µg/L, 4,100 µg/L, and 0.77 µg/L, respectively, between 2000 and 2009. At 800-MW-5, nitrite, sulfide, and methane were reported at concentrations up to 100 µg/L, 3,800 µg/L, and 3.6 µg/L, respectively, between 2000 and 2004. The presence of nitrite, sulfide, and methane at these elevated concentrations indicate that reduction processes are occurring in the subsurface. Therefore, even though 2018 DO and ORP values are more suggestive of aerobic and oxidizing conditions, the groundwater has been under more reducing conditions in the past or there are zones in the subsurface where more reducing conditions are present. The presence of methane could potentially also be a degradation product of HMX (Battelle, 2015). The pH values measured in 2018 were neutral (between 6.02 and 8.57), which is favorable for biological activity. Under these geochemical conditions, anaerobic biodegradation of explosives and 1,2-DCA should be favorable in some portions of the aquifer, including where the greatest concentrations have been reported. TNT may also be degrading under abiotic transformation processes.

- Physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in cross-gradient and downgradient wells (such as 800-MW-13, 800-MW-18, 800-MW-20, G-43, G-47, and L800-TT-MW04). While the explosives exhibiting the greatest concentrations at the site (RDX, HMX, TNT, 1,3,5-TNB, 4-amino-2,6-DNT, and 2-amino-4,6-DNT) in groundwater and the VOC 1,2-DCA have relatively low sorption potential, they should be retarded somewhat as they sorb to the clay geology. However, these explosives have limited volatility (Table 4.2-1) and therefore are unlikely to volatilize into soil gas at the water table interface. On the contrary, the VOC 1,2-DCA has a high volatility. The explosives in groundwater have moderate solubility while 1,2-DCA has high solubility, increasing its mobility in groundwater.

5.7.7 Human Health Risk Assessment

An HHRA was prepared for Line 800 and Pinkwater Lagoon to evaluate potential current and future health risks and hazards from exposure to chemicals in site groundwater. Soil media within Line 800 is not included in the HHRA as it is not a component of this RI; soil is addressed under the remedy for OU-1 (IAAP-003) (Leidos, 2018). As discussed in Section 5.7.1.3, contaminants in soil were removed to meet their OU-1 RGs under multiple removal actions, with the exception of RDX and TNT at one area. At the Pinkwater Lagoon, an interim remedial action is in place for soil, sediment, and surface water within the former leaching pond; therefore, these media at the Pinkwater Lagoon are not evaluated in this HHRA. The interim action does not address groundwater at the Pinkwater Lagoon. There are no other perennial surface water features within the Line 800 site boundary.

The HHRA was conducted in accordance with the final UFP-QAPP (CH2M, 2017a), with the exception of some deviations that were agreed to during meetings or in correspondence with USACE and USEPA following approval of the final UFP-QAPP. The approach and method used to conduct the HHRA are provided in Section 4.3.1. This section presents the CEM for Line 800 and Pinkwater Lagoon and provides the results of the four-step evaluation process composed of:

- Data evaluation.
- Exposure assessment.

- Toxicity assessment.
- Risk characterization.

The results of the HHRA are used to determine if further action is warranted for groundwater at Line 800 and Pinkwater Lagoon.

5.7.7.1 Conceptual Exposure Model

A description of Line 800 and Pinkwater Lagoon, its operational history, previous investigations, and remedial actions are provided in Sections 5.7.1 and 5.7.2.

Line 800 was used to renovate medium- to major-caliber shells and bombs, recover ammonium nitrate as liquor, recover TNT for reprocessing, and recondition and repaint shells and bomb casings (Tetra Tech, 2006b). Line 800 is no longer in use, and all buildings have been demolished; the site is encompassed by a security fence. The Pinkwater Lagoon was used as a leaching pond for wastewater but was converted to a constructed wetland treatment cell in 1998. The lagoon is surrounded predominantly by grass-covered areas and small roadways. The Pinkwater Lagoon is partially open to recreational activities; therefore, hunting is permitted within the site boundary. There are no other perennial surface water features within Line 800. As mentioned previously, an interim remedial action is in place for soil, sediment, and surface water within the former leaching pond at the Pinkwater Lagoon. Culverts are present at the site; therefore, potential groundwater exposures by future construction/ utility workers are complete at Line 800 and Pinkwater Lagoon.

Groundwater is not currently being used as a potable water source, and there are no plans to use groundwater for potable purposes in the future; however, based on applicable CERCLA policy and guidance, groundwater at Line 800 and Pinkwater Lagoon is classified as Class IIB, a potential source of drinking water (USEPA, 1989). Therefore, the HHRA for Line 800 and Pinkwater Lagoon evaluates potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater.

There are no potentially complete exposure pathways being evaluated under current site conditions because of the interim remedy in place for soil, sediment, and surface water within the former leaching pond at the Pinkwater Lagoon. The following potential future human receptors were identified in the HHRA for Line 800 and Pinkwater Lagoon:

- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 800 and Pinkwater Lagoon and could be exposed to indoor air (that may be impacted by volatile chemicals migrating from groundwater) in buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 800 and Pinkwater Lagoon.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on its potential future use as a drinking water source at Line 800 and Pinkwater Lagoon and could be exposed to indoor air (that may be impacted by volatile chemicals migrating from groundwater) in buildings.

As discussed in Section 4.3.1, potential exposures and risks and hazards to future site workers and construction/utility workers are estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels and COCs are identified for a residential scenario. The human health CEM presenting potential exposure media, exposure points, receptors, and exposure routes is provided in Appendix A-8, Attachment 1 (Table 1), and depicted graphically on Figure 5.7-15.

5.7.7.2 Data Evaluation

Data Used in the HHRA

Historical groundwater samples collected from 2004, 2005, and 2007 to 2009 and recent groundwater samples from 2018 were used in the HHRA for Line 800 and Pinkwater Lagoon. The groundwater samples were analyzed for the following:

- 2004, 2005: explosives, metals, one SVOC (1,4-oxathione), and VOCs.
- 2007 to 2009: explosives, metals, and SVOCs.
- 2018: explosives.

Only VOC data from 2004 and 2005 and only metals from 2004 and 2009 were used in HHRA because the full suite of VOCs and metals were analyzed. As stated in the UFP-QAPP (CH2M, 2017a), "Older data (i.e., data collected prior to 2012) may be used in the human health risk assessments if they are still representative of the site (i.e., groundwater flow is slow), chemicals have properties where there would not be a significant reduction in concentrations over time (e.g., metals), or data are conservative for site conditions." Line 800 and Pinkwater Lagoon are no longer operational, as described in Section 5.7.1. Due to a lack of continuing sources, historical concentrations in groundwater are expected to have remained stable or even decreased due to natural attenuation processes. Therefore, the assumptions in the final UFP-QAPP still hold. Samples collected prior to 2012 are considered representative of, or more conservative than, current conditions at Line 800 and Pinkwater Lagoon.

A total of 177 groundwater samples were used to evaluate potential exposures for both a potable use scenario and the VI pathway. The groundwater samples were not collected at multilevel wells; therefore, a separate data grouping (based on shallow groundwater only) was not used to evaluate the VI pathway. A separate groundwater data grouping was used to evaluate a construction/utility worker scenario, assuming construction/utility workers could be exposed to groundwater encountered at depths up to 10 feet bgs while replacing a culvert. Thirty-four groundwater samples were used to evaluate potential exposures in a trench for a construction/utility worker.

Table 5.7-8 lists the number of chemicals analyzed and detected in groundwater at Line 800 and Pinkwater Lagoon:

Table 5.7-8. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Groundwater		
Explosives	17	17
Metals, Total	23	20
SVOCs	1	1
VOCs	44	4

A description of the data groupings and samples included in the HHRA are provided in Tables 5.7-9 and 5.7-10, respectively. The analytical dataset used in the HHRA is included as Appendix A-8, Attachment 2. The groundwater sampling locations included in the HHRA are depicted on Figure 5.4-16.

Screening Results for Site-related Chemicals of Potential Concern and Naturally Occurring Chemicals

The approach and SLs used to select the COPCs (site-related COPCs or naturally occurring chemicals) are described in Section 4.3.1. The results of the COPC screening process for a future site worker, hypothetical resident, and construction/utility worker potentially exposed to groundwater are provided in Appendix A-8, Attachment 1 (Tables 2.1 through 2.3). The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are summarized in Tables 5.7-11 and 5.7-12.

Table 5.7-11. Summary of COPCs for Line 800 and Pinkwater Lagoon—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water				
Future Site Worker and Future Hypothetical Resident	1,3,5-TNB	12/85	0.05	130
	1,3-Dinitrobenzene	1/31	7.6	7.6
	TNT	10/85	0.23	27000
	2,4-DNT	10/85	0.19	260
	2,6-DNT	16/85	0.058	120
	2-Amino-4,6-DNT	16/85	0.11	4900
	2-Nitrotoluene	1/85	0.51	0.51
	3-Nitrotoluene	3/85	1.4	7.8
	4-Amino-2,6-DNT	18/85	0.23	2200
	HMX	42/85	0.084	697
	Nitrobenzene	3/85	0.36	3.4
	RDX	46/85	0.059	6500
	Antimony	3/3	2.7	5.5
	Barium	10/10	108	1090
	Cobalt	1/3	4.4	4.4
	Iron	36/41	44.3	380000
	Manganese	41/41	5.1	32600
	1,1,2-Trichlorotrifluoroethane (Freon 113)	4/4	4.3	2900
	1,2-Dichloroethane	2/4	3	6.2
Groundwater to Indoor Air via Vapor Intrusion				
Future Site Worker and Future Hypothetical Resident	1,1,2-Trichlorotrifluoroethane (Freon 113)	4/4	4.3	2900
	1,2-Dichloroethane	2/4	3	6.2
Shallow Groundwater in a Trench (<10 ft bgs)				
	TNT	1/15	9.7	9.7
	2,4-DNT	1/15	3.2	3.2

Table 5.7-11. Summary of COPCs for Line 800 and Pinkwater Lagoon—Site-Related
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Future Construction/Utility Worker	2,6-DNT	1/15	4.3	4.3
	2-Amino-4,6-DNT	1/15	18	18
	2-Nitrotoluene	1/15	0.51	0.51
	4-Amino-2,6-DNT	1/15	30	30
	HMX	7/15	0.084	190
	Nitrobenzene	2/15	0.43	3.4
	RDX	7/15	0.059	630
	Antimony	1/1	4.5	4.5
	Iron	10/11	4150	380000
	Manganese	11/11	66.8	32600

Table 5.7-12. Summary of COPCs for Line 800 and Pinkwater Lagoon—Naturally Occurring
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water				
Future Site Worker and Future Hypothetical Resident	Arsenic	3/10	3.5	4.8
	Cadmium	3/10	0.68	1.1
	Chromium	5/10	0.52	8.6
Shallow Groundwater in a Trench (<10 ft bgs)				
Future Construction/Utility Worker	Cadmium	1/1	1.1	1.1
	Chromium	1/1	0.52	0.52

5.7.7.3 Exposure Assessment

Line 800 and the Pinkwater Lagoon are no longer active, and no buildings are present at the site. However, there are plans for a new Long Range Precision Artillery Product Facility at the site. Pinkwater Lagoon was used as a leaching pond for wastewater but was converted to a constructed wetland treatment cell. Line 800 and Pinkwater Lagoon are partially open to recreational activities and hunting is permitted within the site boundary. Soil, surface water and sediment in the pond at the Pinkwater Lagoon have been addressed via the interim remedial action. No other perennial surface water or sediment is present at Line 800.

As previously discussed, groundwater is not currently being used as a potable water source; however, the HHRA for Line 800 and Pinkwater Lagoon evaluated potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater. Therefore, ingestion, dermal contact, and inhalation exposures to COPCs in groundwater were evaluated for future site workers and hypothetical residents. Culverts are located at Line 800 and Pinkwater Lagoon; therefore, potential ingestion, dermal contact, and inhalation exposures to shallow groundwater in a trench were evaluated for future construction/utility workers. As noted previously, risks and hazards for site workers and construction/utility workers are estimated only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk and hazard levels and COCs are identified for a residential scenario. The potential exposure pathways quantified in the HHRA are included in Appendix A-8, Attachment 1 (Table 1), and in Figure 5.7-15. The following receptor scenarios were quantified in the HHRA for the Line 800 and Pinkwater Lagoon:

- Future site worker.
  - Groundwater (tap water) COPCs—ingestion and dermal contact.
  - Groundwater (vapor intrusion) COPCs—inhalation of volatiles in indoor air.
- Future construction/utility worker.
  - Shallow groundwater (trench, 0 to 10 feet bgs) COPCs—incidental ingestion, dermal contact and inhalation of volatiles.
- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion, dermal contact, and inhalation of volatiles in household air.
  - Groundwater (vapor intrusion) COPCs—inhalation of volatiles in indoor air.

Risks and hazards for site workers and construction/utility workers were quantified in the HHRA because the estimated risks or hazards for a hypothetical residential scenario exceeded acceptable risk or hazard levels and COCs were identified for a residential scenario.

In accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b), groundwater EPCs are typically calculated based on the data collected in the core of a plume. One RDX plume is present that extends from the southeastern portion of Line 800 and runs beneath the Pinkwater Lagoon (Figure 5.7-6). Forty-five monitoring wells (see Table 5.7-10) are located within the core of the plume; 112 groundwater samples are available in the HHRA dataset for the RDX plume. If the MDC of a groundwater COPC was not in the subset of wells from the core of the RDX plume, the MDC of the COPC in the sitewide groundwater data set was used.

For groundwater, where sufficient number of samples and detected concentrations are available for COPCs, the UCL on the mean is selected as the EPC. For COPCs where fewer than eight samples or four detects were available, the MDCs were selected as the EPC. For antimony, arsenic, barium, cadmium, and cobalt, the MDCs were located outside of the RDX plume and were used for the EPCs. The groundwater EPCs used to estimate the chemical daily intakes and ECs for groundwater are provided in Appendix A-8, Attachment 1 (Tables 3.1 through 3.3).

The exposure factors used in the daily intake and EC calculations for receptor scenarios are included in Appendix A-8, Attachment 1 (Tables 4.1 through 4.5). The primary references for the exposure factor values are the standard default exposure factors presented in the HHEM *Update of Standard Default Exposure Factors* (USEPA, 2014a).

One COPC (chromium) was identified as acting with an MMOA in site media. The ADAFs and exposure assumptions used to calculate adjusted intakes for chromium are provided in Appendix A-8, Attachment 1 (Table 4 Supplement A).

5.7.7.4 Toxicity Assessment

The oral toxicity values (CSFs and RfDs) and inhalation toxicity values (IURs and RfCs) used in the HHRA were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as provided in Section 4.3.1. Noncancer toxicity values for the COPCs identified at Line 800 and Pinkwater Lagoon are provided in Appendix A-8, Attachment 1 (Tables 5.1 and 5.2). Cancer toxicity values for the COPCs are provided in Appendix A-8, Attachment 1 (Tables 6.1 and 6.2).

5.7.7.5 Risk Characterization

The risk characterization for Line 800 and Pinkwater Lagoon was completed using a four-step process, as discussed in Section 4.3.1. The results of each step are discussed below.

Step 1: Total Combined Risks and Hazards from Site-related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculating receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. The estimated risks and hazards for a hypothetical residential scenario are summarized in Table 5.7-13.

Table 5.7-13. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

				Line 800 and Pinkwater Lagoon		
Receptor[a]	**ELCR/HI Tables (RME) in Appendix A-8, Attachment 1**	**Exposure Medium**	**COPC/Chemical**	**EPC [b]**	**ELCR**	**HI**
Hypothetical Resident (Adult)	7.1 and 9.1	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	39,800	NA	8
			1,2-Dichloroethane	0.171	NA	0.02
			Total HI (Groundwater—Indoor Air):		**NA**	**8**
		Groundwater (Tap water)	1,3,5-TNB	8.2	NA	0.008
			1,3-Dinitrobenzene	7.6	NA	2
			TNT	174	NA	11
			2,4-DNT	12	NA	0.2
			2,6-DNT	4.0	NA	0.4
			2-Amino-4,6-DNT	25	NA	8
			2-Nitrotoluene	0.51	NA	0.02
			3-Nitrotoluene	7.8	NA	3
			4-Amino-2,6-DNT	28	NA	9
			HMX	118	NA	0.07
			Nitrobenzene	3.4	NA	0.2
			RDX	974	NA	7
			Antimony	5.5	NA	0.4
			Arsenic	4.8	NA	0.5
			Barium	1,090	NA	0.2

Table 5.7-13. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor[a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	ELCR	HI
			Cadmium	1.1	NA	0.08
			Chromium	8.6	NA	0.1
			Cobalt	4.4	NA	0.4
			Iron	120,025	NA	5
			Manganese	12,792	NA	18
			1,1,2-Trichlorotrifluoroethane (Freon 113)	2,900	NA	0.3
			1,2-Dichloroethane	6.2	NA	0.5
		Total HI (Groundwater—Tap Water):			**NA**	**67**
		Total HI (Groundwater—Indoor Air and Tap Water):			**NA**	**74**
Hypothetical Resident (Child)	7.2 and 9.2	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	39,800	NA	8
			1,2-Dichloroethane	0.171	NA	0.02
			Total HI (Groundwater—Indoor Air):		**NA**	**8**
		Groundwater (Tap water)	1,3,5-TNB	8.2	NA	0.01
			1,3-Dinitrobenzene	7.6	NA	4
			TNT	174	NA	18
			2,4-DNT	12	NA	0.3
			2,6-DNT	4.0	NA	0.7
			2-Amino-4,6-DNT	25	NA	13
			2-Nitrotoluene	0.51	NA	0.03
			3-Nitrotoluene	7.8	NA	4
			4-Amino-2,6-DNT	28	NA	15
			HMX	118	NA	0.1
			Nitrobenzene	3.4	NA	0.3
			RDX	974	NA	12
			Antimony	5.5	NA	0.7
			Arsenic	4.8	NA	0.8
			Barium	1,090	NA	0.3
			Cadmium	1.1	NA	0.1
			Chromium	8.6	NA	0.2

Table 5.7-13. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, Iowa

Receptor[a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	ELCR	HI
			Cobalt	4.4	NA	0.7
			Iron	120,025	NA	9
			Manganese	12,792	NA	30
			1,1,2-Trichlorotrifluoroethane (Freon 113)	2,900	NA	0.3
			1,2-Dichloroethane	6.2	NA	0.5
			Total HI (Groundwater—Tap Water):		**NA**	**109**
			Total HI (Groundwater—Indoor Air and Tap Water):		**NA**	**117**
Hypothetical Resident (Adult/Child Aggregate)	7.3 and 9.3	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	39,800	NA	NA
			1,2-Dichloroethane	0.171	2E-06	NA
			Total ELCR (Groundwater—Indoor Air):		**2E-06**	**NA**
		Groundwater (Tap water)	1,3,5-TNB	8.2	NA	NA
			1,3-Dinitrobenzene	7.6	NA	NA
			TNT	174	7E-05	NA
			2,4-DNT	12	5E-05	NA
			2,6-DNT	4.0	8E-05	NA
			2-Amino-4,6-DNT	25	NA	NA
			2-Nitrotoluene	0.51	2E-06	NA
			3-Nitrotoluene	7.8	NA	NA
			4-Amino-2,6-DNT	28	NA	NA
			HMX	118	NA	NA
			Nitrobenzene	3.4	2E-05	NA
			RDX	974	1E-03	NA
			Antimony	5.5	NA	NA
			Arsenic	4.8	9E-05	NA
			Barium	1,090	NA	NA
			Cadmium	1.1	NA	NA
			Chromium	8.6	2E-04	NA
			Cobalt	4.4	NA	NA

Table 5.7-13. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor[a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	**ELCR**	**HI**
			Iron	120,025	NA	NA
			Manganese	12,792	NA	NA
			1,1,2-Trichlorotrifluoroethane (Freon 113)	2,900	NA	NA
			1,2-Dichloroethane	6.2	4E-05	NA
		Total ELCR (Groundwater—Tap Water):			**2E-03**	**NA**
		Total ELCR (Groundwater—Indoor Air and Tap Water):			**2E-03**	**NA**

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (indoor air)—µg/m^3; groundwater (tap water)—µg/L

NA = not applicable

RME = reasonable maximum exposure

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculation of receptor-specific ELCRs and HIs for naturally occurring chemicals. Three COPCs (arsenic, cadmium, and chromium) were identified as naturally occurring chemicals in site groundwater at Line 800 and Pinkwater Lagoon, as discussed in Section 5.7.5.2. The MDCs of arsenic and cadmium were less than their respective BTVs. The MDCs of chromium in the most recent sampling events (2001 and 2004) were also less than the BTV. The estimated risks and hazards for the naturally occurring chemicals in groundwater for a future hypothetical residential scenario are provided in Table 5.7-14. The naturally occurring chemicals are not used to identify the final COCs for Line 800 and Pinkwater Lagoon and are not discussed further in the HHRA after this step.

Table 5.7-14. Summary of Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	**ELCR**	**HI**
Hypothetical Resident (Adult)	7.4 and 9.4	Groundwater (Tap Water)	Arsenic	4.8	NA	0.5
			Cadmium	1.1	NA	0.08
			Chromium	8.6	NA	0.1
			Total HI (Groundwater—Tap Water):		**NA**	**1**

Table 5.7-14. Summary of Risk and Hazard Estimates for Naturally Occurring Chemicals—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	ELCR	HI
Hypothetical Resident (Child)	7.5 and 9.5	Groundwater (Tap Water)	Arsenic	4.8	NA	0.8
			Cadmium	1.1	NA	0.1
			Chromium	8.6	NA	0.2
			Total HI (Groundwater—Tap Water):		**NA**	**2**
Hypothetical Resident Adult/Child Aggregate)	7.6 and 9.6	Groundwater (Tap water)	Arsenic	4.8	9E-05	NA
			Cadmium	1.1	NA	NA
			Chromium	8.6	2E-04	NA
Total ELCR (Groundwater—Tap Water):					**3E-04**	**NA**

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (tap water)—µg/L

NA = not applicable

RME = reasonable maximum exposure

Step 3: Risk Characterization of Site-related COPCs

Step 3 consists of calculating receptor-specific ELCRs and HIs associated with site-related COPCs. Twelve explosives, five metals, and two VOCs were identified as site-related COPCs for groundwater at Line 800 and Pinkwater Lagoon. The estimated risks and hazards for site-related COPCs in groundwater for a hypothetical resident are provided in Table 5.7-15.

Table 5.7-15. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	ELCR	HI
Site Worker (Adult)	7.7 and 9.7	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	39,800	NA	2
			1,2-Dichloroethane	0.171	4E-07	0.006
			Total ELCR and HI (Groundwater—Indoor Air):		**4E-07**	**2**
		Groundwater (Tap Water)	1,3,5-TNB	8.2	NA	0.002
			1,3-Dinitrobenzene	7.6	NA	0.7
			TNT	174	2E-05	3
			2,4-DNT	12	1E-05	0.05
			2,6-DNT	4.0	2E-05	0.1

Table 5.7-15. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	**ELCR**	**HI**
			2-Amino-4,6-DNT	25	NA	2
			2-Nitrotoluene	0.51	4E-07	0.005
			3-Nitrotoluene	7.8	NA	0.7
			4-Amino-2,6-DNT	28	NA	2
			HMX	118	NA	0.02
			Nitrobenzene	3.4	4E-09	0.01
			RDX	974	2E-04	2
			Antimony	5.5	NA	0.1
			Barium	1,090	NA	0.05
			Cobalt	4.4	NA	0.1
			Iron	120,025	NA	1
			Manganese	12,792	NA	5
			1,1,2-Trichlorotrifluoroethane (Freon 113)	2,900	NA	0.0009
			1,2-Dichloroethane	6.2	2E-06	0.01
			Total HI and ELCR (Groundwater):		3E-04[c]	17[d]
		Total HI and ELCR (Groundwater—Indoor Air and Tap Water):			3E-04[c]	19[d]
Construction/ Utility Worker (Adult)	7.8 and 9.8	Groundwater (Trench)	TNT	9.7	7E-11	0.008
			2,4-DNT	3.2	5E-10	0.0004
			2,6-DNT	4.3	3E-08	0.0005
			2-Amino-4,6-DNT	18	NA	0.02
			2-Nitrotoluene	0.51	1E-9	0.00004
			4-Amino-2,6-DNT	30	NA	0.03
			HMX	190	NA	0.0005
			Nitrobenzene	3.4	1E-07	0.3
			RDX	630	3E-08	0.001
			Antimony	4.5	NA	0.08
			Iron	380,000	NA	0.08
			Manganese	32,600	NA	1
			Total HI and ELCR (Groundwater):		**2E-07**	**2[e]**

Table 5.7-15. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.9 and 9.9	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	39,800	NA	8
			1,2-Dichloroethane	0.171	NA	0.02
			Total HI (Groundwater—Indoor Air):		**NA**	**8**
		Groundwater (Tap water)	1,3,5-TNB	8.2	NA	0.008
			1,3-Dinitrobenzene	7.6	NA	2
			TNT	174	NA	11
			2,4-DNT	12	NA	0.2
			2,6-DNT	4.0	NA	0.4
			2-Amino-4,6-DNT	25	NA	8
			2-Nitrotoluene	0.51	NA	0.02
			3-Nitrotoluene	7.8	NA	3
			4-Amino-2,6-DNT	28	NA	9
			HMX	118	NA	0.07
			Nitrobenzene	3.4	NA	0.2
			RDX	974	NA	7
			Antimony	5.5	NA	0.4
			Barium	1,090	NA	0.2
			Cobalt	4.4	NA	0.4
			Iron	120,025	NA	5
			Manganese	12,792	NA	18
			1,1,2-Trichlorotrifluoroethane (Freon 113)	2,900	NA	0.3
			1,2-Dichloroethane	6.2	NA	0.5
			Total HI (Groundwater—Tap Water):		**NA**	**66[f]**
		Total HI (Groundwater—Indoor Air + Tap Water):			**NA**	**74[f]**
Hypothetical Resident (Child)	7.10 and 9.10	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	39,800	NA	8
			1,2-Dichloroethane	0.171	NA	0.02
			Total HI (Groundwater—Indoor Air):		**NA**	**8**
		Groundwater (Tap water)	1,3,5-TNB	8.2	NA	0.01

Table 5.7-15. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	**ELCR**	**HI**
			1,3-Dinitrobenzene	7.6	NA	4
			TNT	174	NA	18
			2,4-DNT	12	NA	0.3
			2,6-DNT	4.0	NA	0.7
			2-Amino-4,6-DNT	25	NA	13
			2-Nitrotoluene	0.51	NA	0.03
			3-Nitrotoluene	7.8	NA	4
			4-Amino-2,6-DNT	28	NA	15
			HMX	118	NA	0.1
			Nitrobenzene	3.4	NA	0.3
			RDX	974	NA	12
			Antimony	5.5	NA	0.7
			Barium	1,090	NA	0.3
			Cobalt	4.4	NA	0.7
			Iron	120,025	NA	9
			Manganese	12,792	NA	30
			1,1,2-Trichlorotrifluoroethane (Freon 113)	2,900	NA	0.3
			1,2-Dichloroethane	6.2	NA	0.5
			Total HI (Groundwater—Tap Water):		**NA**	**108[f]**
		Total HI (Groundwater—Indoor Air and Tap Water):			**NA**	**116[f]**
Groundwater (Tap Water)	7.11 and 9.11	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	39,800	NA	NA
			1,2-Dichloroethane	0.171	2E-06	NA
			Total ELCR (Groundwater—Indoor Air):		**2E-06**	**NA**
			1,3,5-TNB	8.2	NA	NA
			1,3-Dinitrobenzene	7.6	NA	NA
			TNT	174	7E-05	NA
			2,4-DNT	12	5E-05	NA
			2,6-DNT	4.0	8E-05	NA
			2-Amino-4,6-DNT	25	NA	NA

Table 5.7-15. Summary of Risk and Hazard Estimates for Site-Related COPCs—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-8, Attachment 1	Exposure Medium	COPC/Chemical	Line 800 and Pinkwater Lagoon		
				EPC [b]	ELCR	HI
			2-Nitrotoluene	0.51	2E-06	NA
			3-Nitrotoluene	7.8	NA	NA
			4-Amino-2,6-DNT	28	NA	NA
			HMX	118	NA	NA
			Nitrobenzene	3.4	2E-05	NA
			RDX	974	1E-03	NA
			Antimony	5.5	NA	NA
			Barium	1,090	NA	NA
			Cobalt	4.4	NA	NA
			Iron	120,025	NA	NA
			Manganese	12,792	NA	NA
			1,1,2-Trichlorotrifluoroethane (Freon 113)	2,900	NA	NA
			1,2-Dichloroethane	6.2	3E-05	NA
			Total ELCR (Groundwater—Tap Water):		**1E-03[g]**	**NA**
		Total ELCR (Groundwater—Indoor Air and Tap Water):			**1E-03[g]**	**NA**

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (indoor air)—micrograms per cubic meter; groundwater (tap water)—micrograms per liter

[c] The ELCR exceeds 1×10^{-4} (due to TNT, 2,4-DNT, 2,6-DNT, RDX, and 1,2-DCA)—Appendix A-8, Attachment 1 (see Table 9.7).

[d] The HIs for NOE (due to Freon 113), hepatic (due to TNT, 2-Amino-4,6-DNT and 4-Amino-2,6-DNT) and nervous system (RDX and Manganese) exceed 1—Appendix A-8, Attachment 1 (see Table 9.7).

[e] Although the total HI exceeds 1, none of the target organ HIs exceed 1.

[f] The HIs for NOE (due to Freon 113), gastrointestinal (due to Iron), hepatic (due to TNT, 2,4-DNT, 2-Amino-4,6-DNT and 4-Amino-2,6-DNT), immune (due to 1,3-dinitrobenzene, 2,6-DNT, and 3-nitrotoluene) and nervous system (due to 2,4-DNT, RDX, nitrobenzene, 1,2-DCA, and manganese) exceed 1—Appendix A-8, Attachment 1 (see Tables 9.9 and 9.10).

[g] The ELCR exceeds 1×10^{-4} (due to TNT, 2,4-DNT, 2,6-DNT, 2-nitrotoluene, RDX, nitrobenzene, and 1,2-DCA)—Appendix A-8, Attachment 1 (see Table 9.11).

NA = not applicable

RME = reasonable maximum exposure

Step 4: Final COC Determination

For groundwater potable use by future hypothetical residents, the target organ–specific HIs exceeded USEPA's threshold of 1 and cumulative ELCR exceeded USEPA's acceptable risk range (1×10^{-6} to 1×10^{-4}) due to the COPCs indicated in Table 5.7-16:

Table 5.7-16. COPCs Exceeding USEPA Target Thresholds—Future Hypothetical Residents
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1 × 10^{-4}
Iron Manganese 1,3-Dinitrobenzene 2,4-DNT 2,6-DNT 2-Amino-4,6-DNT 3-Nitrotoluene 4-Amino-2,6-DNT RDX TNT Nitrobenzene 1,1,2-Trichlorotrifluoroethane (Freon 113) 1,2-DCA	2,4-DNT 2,6-DNT 2-Nitrotoluene RDX TNT 1,2-DCA Nitrobenzene

These chemicals were identified as COCs in groundwater for future hypothetical residents. Therefore, potential exposures and risks and hazards were also estimated for future site workers and construction/utility workers (summarized in Table 5.7-15).

The maximum detected manganese groundwater concentration was compared to DRI-based screening levels; however, the maximum detected concentration exceeded the screening levels. Therefore, manganese was retained as a COC in groundwater (Table 5.7-17).

Table 5.7-17. Comparison of Manganese Concentration to Screening Levels Developed from the DRI
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical	Maximum Concentration (µg/L)	Adult Screening Level (µg/L)	Child Screening Level (µg/L)	Exceeds SL?	Groundwater COC?
Manganese	12,792	751	451	Yes	Yes

See Appendix A-1, Attachment 5 for development of the DRI-based screening levels.

For potable use of groundwater by future site workers, the target organ–specific HIs exceeded USEPA's threshold of 1 and cumulative ELCR exceeded USEPA's acceptable risk range (1 × 10^{-6} to 1 × 10^{-4}) due to the COPCs indicated in Table 5.7-18:

Table 5.7-18. COPCs Exceeding USEPA Target Thresholds—Future Site Workers
Iowa Army Ammunition Plant, Middletown, Iowa

Chemicals Contributing to Receptor Target Organ HI > 1	Chemicals Contributing to Receptor ELCR > 1 × 10^{-4}
Manganese TNT 2-Amino-4,6-DNT 4-Amino-2,6-DNT RDX 1,1,2-Trichlorotrifluoroethane (Freon 113)	TNT RDX

For contact with shallow groundwater by future construction/utility workers, the cumulative ELCR and HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1, respectively, and no COCs were identified for this receptor.

In summary, the following COCs were identified for groundwater, as presented in Appendix A-8, Attachment 1 tables (Table 5.7-19):

Table 5.7-19. Final COCs identified for Groundwater at Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

COC	Site Workers (Table 10.1)	Hypothetical Residents (Tables 10.2–10.4)
Iron	—	X
Manganese	X	X
1,3-Dinitrobenzene	—	X
2,4-DNT	—	X
2,6-DNT	—	X
2-Amino-4,6-DNT	X	X
2-Nitrotoluene	—	X
3-Nitrotoluene	—	X
4-Amino-2,6-DNT	X	X
RDX	X	X
TNT	X	X
Nitrobenzene	—	X
1,1,2-Trichlorotrifluoroethane (Freon 113)	X	X
1,2-DCA	—	X

5.7.7.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. The general uncertainties associated with the HHRAs for the sites in this RI report are provided in Section 4.3.1. This section provides additional site-specific uncertainties associated with the HHRA for Line 800 and Pinkwater Lagoon that are not included in Section 4.3.1.

Hazard estimates for 2,6-DNT, 2-amino-4,6-DNT, 3-nitrotoluene, and 4-amino-2,6-DNT could be over- or underestimated because screening RfDs were used in the risk calculations. As stated in the PPRTV documents for 2-amino-4,6-DNT and 4-amino-2,6-DNT (USEPA, 2009b, 2013, 2020a, 2020b),

> It is inappropriate to derive a subchronic or chronic provisional RfD for [2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 3-nitrotoluene, or 4-amino-2,6-dinitrotoluene]. However, information is available which, although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors…. Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of a supplemental screening toxicity value than for a value presented in the body of the assessment.

Chemicals that were 100 percent not detected in an exposure medium were not included in the COPC identification process; however, they were evaluated in a separate screening to determine whether elevated nondetected results were present in site media. The detailed analysis of the nondetected chemicals at Line 800 and Pinkwater Lagoon is provided in Appendix A-8, Attachment 4. In summary, one metal (thallium) and 14 VOCs have DLs and RLs exceeding SLs at Line 800 and Pinkwater Lagoon. although the RLs and DLs for these nondetect chemicals are greater than the SLs, based on the acceptably low DLs and RLs for the analyzed chemicals and comparison to historically detected chemicals in groundwater at IAAAP, further consideration of nondetect chemicals does not appear warranted in the Line 800 and Pinkwater Lagoon HHRA.

5.7.7.7 Summary of HHRA

An HHRA was prepared for Line 800 and Pinkwater Lagoon to evaluate potential current and future health risks from exposure to chemicals in site groundwater. Line 800 and the Pinkwater Lagoon are no longer active, and no buildings are present at the site. The site is partially open to recreational activities and hunting is permitted within the site boundary. No perennial surface water or sediment is present at Line 800, and soil is addressed under the remedy for OU-1. Soil, surface water, and sediment in the pond at the Pinkwater Lagoon have been addressed via the interim remedial action.

The following potential future human receptors were identified in the HHRA for Line 800 and Pinkwater Lagoon:

- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 800 and Pinkwater Lagoon and could be exposed to indoor air (that may be impacted by volatile chemicals migrating from groundwater) in buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 800 and Pinkwater Lagoon.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 800 and Pinkwater Lagoon and could be exposed to indoor air (that may be impacted by volatile chemicals migrating from groundwater) in buildings.

Potential exposures and risks and hazards to future site workers and construction/utility workers were estimated in the HHRA since estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk and hazard levels and COCs were identified for a residential scenario.

The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are as follows:

- Groundwater (potable use):
  - Naturally occurring: arsenic, cadmium, and chromium.
  - Site-related: Cobalt, iron, manganese, 1,3,5-TNB, 1,3-dinitrobenzene, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, HMX, nitrobenzene, RDX, antimony, barium, 1,1,2-trichlorotrifluoroethane (freon 113), and 1,2-DCA.
- Groundwater (vapor intrusion): 1,1,2-trichlorotrifluoroethane (Freon 113), 1,2-DCA
- Groundwater (trench scenario):
  - Naturally occurring: cadmium and chromium.
  - Site-related: Iron, manganese, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 4-amino-2,6-DNT, HMX, nitrobenzene, RDX, and antimony.

The risk characterization for Line 800 and Pinkwater Lagoon was completed using a four-step process, as discussed in Section 4.3.1. Step 1 presents the total combined risks and hazards from site-related COPCs and naturally occurring chemicals, as summarized in Table 5.7-13. Step 2 presents the risks and hazards from naturally occurring chemicals, as summarized in Table 5.7-14. Step 3 presents the risks and hazards from site-related COPCs, as summarized in Table 5.7-15.

Unacceptable groundwater risks and hazards were identified for hypothetical residents, and iron, manganese, 1,3-dinitrobenzene, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, nitrobenzene, RDX, 1,1,2-trichlorotrifluoroethane (Freon 113), and 1,2-DCA were identified as final COCs. Therefore, groundwater risks and hazards were also estimated for future site workers and construction/utility workers. For future site workers, manganese, TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, RDX, and 1,1,2-trichlorotrifluoroethane (Freon 113) were identified as COCs, while no COCs were identified for future construction/utility workers.

In summary, the following COCs were identified for groundwater (Table 5.7-20):

Table 5.7-20. Final COCs for Line 800 and Pinkwater Lagoon Groundwater

Future Site Worker	Future Construction/Utility Worker	Future Hypothetical Resident
Manganese TNT 2-amino-4,6-DNT 4-amino-2,6-DNT RDX 1,1,2-Trichlorotrifluoroethane (Freon 113)	None	Iron Manganese 1,3-Dinitrobenzene TNT 2-amino-4,6-DNT 4-amino-2,6-DNT 2,4-DNT 2,6-DNT 2-Nitrotoluene 3-Nitrotoluene Nitrobenzene RDX 1,1,2-Trichlorotrifluoroethane (Freon 113) 1,2-DCA

5.7.8 Ecological Risk Assessment

The following sections present the results of Step 1 of the SLERA for Line 800.

5.7.8.1 Screening Level Problem Formulation (Step 1)

The screening level problem formulation establishes the goals, scope, and focus of the ERA. As part of the problem formulation, the environmental setting of the site is characterized in terms of the habitats and biota known to be or likely to be present. An ECEM is developed that shows complete exposure pathways. The chemicals that are present in ecologically relevant media are also described based upon available analytical data. Receptors for which ecologically significant exposure pathways exist are evaluated for impact from chemicals present in the relevant media. As discussed in Section 4.3.2, Step 1 of the ERA process is intended to answer two main questions: (1) Do complete exposure pathways exist? and (2) Are sufficient data available to conduct the SLERA? If no complete exposure pathways exist, the ERA process terminates at Step 1 with a conclusion of negligible risk. If one or more complete exposure pathways are known to, or are likely to, exist, the ERA process continues to Step 2, but only those pathways that have been determined to be critical are evaluated. To answer these two questions, the Step 1 results focused on three areas: (1) ecological setting, (2) ECEM, and (3) data usage.

Ecological Setting

Line 800 and Pinkwater Lagoon are located within the Brush Creek and the Long Creek watersheds (Figure 2-1) in the southeastern quadrant of the IAAAP (Figure 1-1). The Line 800 and Pinkwater Lagoon are predominantly grass-covered areas with small roadways, except for a wooded area in the northern third of the Pinkwater Lagoon site. There are no permanent water bodies except for the Pinkwater Lagoon itself, including the constructed wetland. The sites are bounded by wooded areas at the northeast and southwest ends and surrounded by agricultural plots on all other sides. The only potential terrestrial habitat consists of the wooded area to the north of the Pinkwater Lagoon, and the only potential surface water habitat consists of the Pinkwater Lagoon itself.

Ecological Conceptual Exposure Model

The ECEM, presented on Figure 5.7-17, shows complete exposure pathways. Important components of the ECEM are the identification of potential source areas, release mechanisms and transport pathways, exposure media, exposure routes, and receptors. Actual or potential exposures of ecological receptors are determined by identifying the most likely, and most important, pathways of contaminant release and transport. A complete exposure pathway has three components: (1) a source of chemicals (stressors) that results in a release to the environment, (2) a pathway of chemical transport through an environmental medium, and (3) an exposure or contact point for an ecological receptor.

If no complete exposure pathways exist, the ERA process terminates at Step 1 with a conclusion of negligible risk. If one or more complete exposure pathways are known to, or are likely to, exist, the ERA process continues to Step 2, but only those pathways that have been determined to be critical are evaluated. Based on the available habitat the following exposure pathways are potentially complete:

- Ingestion of biota exposed to soil, surface water, or sediment.
- Ingestion of soil, surface water, or sediment.
- Dermal contact with soil, surface water, or sediment.

However, dermal contact, although a potentially complete pathway, is considered a minor exposure; it is only critical to the risk assessment in specialized cases.

Although soil, surface water, sediment, and groundwater show potentially complete pathways, the pond and wetland are under an interim remedial action, and historical samples are not considered representative of current conditions onsite. A summary of the Line 800 and Pinkwater Lagoon relationship with the Long Creek and Brush Creek watersheds is discussed in the watershed ERA (CH2M, 2022) and included in Appendix I.

Water collected in the impoundment and wetland is discharged to Brush Creek downstream of the impoundment. Samples of released effluent were collected approximately weekly from August to October 2020 and analyzed for an explosive chemical (RDX). The greatest observed RDX concentration was 0.35 µg/L, much less than the ESV for RDX in surface water of 79 µg/L. Based on these results, the discharge of treated effluent is not contributing to elevated RDX concentrations in surface water, and therefore, no ecological adverse effects are likely.

5.7.9 Conclusions and Recommendations

An RI was conducted for Line 800 and Pinkwater Lagoon to refine the nature and extent of contamination in groundwater, surface water (lagoon only), and soil/sediment (lagoon only) from historical activities and assess for potential unacceptable risk to human health and the environment. Soil within the Line 800 boundary has been addressed under the remedial action for OU-1 and is not covered under this RI for OU-6. An interim remedial action is in place for soil, sediment, and surface water associated with the Pinkwater Lagoon. The interim action does not address groundwater.

Analytical data available for groundwater at Line 800 and Pinkwater Lagoon include VOCs, SVOCs, PAHs, explosives, metals, PCBs, pesticides, and herbicides. Of these, only explosives, antimony, barium, Freon 113, and 1,2-DCA were identified as site-related chemicals of interest based on historical site operations and a comparison of concentration data to site characterization PALs (listed in Appendix F) and BTVs.

During the most recent groundwater monitoring event in 2018, ten explosives were detected at concentrations greater than their site characterization PALs (1,3,5-TNB, 1,3-DNB, TNT, 2,4-DNT, 2-6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 3-nitrotoluene, nitrobenzene, and RDX). Explosives contamination in groundwater is present as a large, shallow plume that extends from the southeastern portion of Line 800 and runs beneath the Pinkwater Lagoon. RDX is the most extensive chemical, and the other explosives are present within the RDX plume extents. During the current 2018 RI monitoring event, the greatest RDX concentration was reported at shallow overburden monitoring well G-20 (6,500 J µg/L), located at the southwest edge of the lagoon. The lateral and vertical extents of the explosives plume in groundwater have been defined.

An HHRA and an ERA were conducted to quantify potential risks to human health and the environment from exposure to contaminants in groundwater at Line 800 and Pinkwater Lagoon. The following conclusions were made based on the risk assessments:

- The HHRA identified potential unacceptable risks for the following media and receptors:
  - Future hypothetical resident: Potential unacceptable risks and hazards were identified from exposure to iron, manganese, 1,3-dinitrobenzene, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, nitrobenzene, RDX, 1,1,2-trichlorotrifluoroethane (Freon 113), and 1,2-DCA in groundwater. These chemicals were identified as COCs for future hypothetical residents.
  - Future construction/utility workers: No potential unacceptable risks were identified for exposure to groundwater.
  - Future site workers: Potential unacceptable risks associated with exposure to manganese, TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, RDX, and 1,1,2-trichlorotrifluoroethane (Freon 113) in groundwater were identified.
- The ERA concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective for groundwater at Line 800 and Pinkwater Lagoon. RDX concentrations in surface water collected from Pinkwater Lagoon are much less than the surface water ESV.

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs at Line 800 and Pinkwater Lagoon. For groundwater at Line 800 and Pinkwater Lagoon (IAAP-044G), metals (iron and manganese), explosives (1,3-dinitrobenzene, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, nitrobenzene, RDX), and VOCs (1,1,2-trichlorotrifluoroethane [Freon 113], and 1,2-DCA) were identified as COCs. For soil, surface water, and sediment at Pinkwater Lagoon (IAAP-044G), the Action Memorandum for the Line 1 Impoundment and Pinkwater Lagoon (CDM, 1996) previously identified explosives (HMX, RDX, TNT, 1,3,5-TNB, 1,3-dinitrobenzene, nitrobenzene, DNTs, nitrotoluene, and tetryl) as COCs. Under the O&M plan (Aerostar, 2016), lagoon water is regularly monitored for RDX concentrations.

For administrative purposes, groundwater, surface water, and sediment are retained under the same AEDB number (IAAP-044G). As previously mentioned, although the sites are merged, soil within Line 800 has been identified under IAAP-011 in recent OU-1 reports, and soil at Pinkwater Lagoon has been addressed under IAAP-044. Because soil and sediment are addressed by the interim remedial action, which will require ongoing O&M, it is recommended that both of these IAAAP sites (IAAP-044 and IAAP-044G) be transferred to OU-7, which includes other sites that require ongoing maintenance (such as disposal or waste pile sites).

Under OU-7, an FS should be conducted to evaluate remedial alternatives to address the unacceptable risks in groundwater. It is recommended that the interim remedial action be proposed and selected as the final remedy for soil, surface water, and sediment at Pinkwater Lagoon and that O&M of the system continue.

5.8 IAAP-010G_Line 9 Ammo LAP (Mine) Groundwater (19105.1014)

This subsection summarizes RI activities at Line 9. This report documents the RI for groundwater at Line 9 (IAAP-010G). Soil is addressed under the remedy for OU-1 (IAAP-010) (Leidos, 2018). There are no perennial surface water features within the Line 9 boundary.

5.8.1 Background

5.8.1.1 Site Description

Line 9 Ammo LAP (Mine) is located in the central portion of the IAAAP facility (Figure 5.8-1). The CWWP (Tetra Tech, 2006b), identified Line 9 as the "percussion line" over an area of approximately 9 acres; however, the site boundary encompasses over 80 acres (Figure 5.8-1). The site is situated in the Brush Creek watershed and is directly south of the Line 6 Ammo Production site. Historically, Line 9 included 38 buildings; however, former production buildings at Line 9 were removed in 2010 as part of the Army's Facilities Reduction Program (Bhate, 2011). The site currently includes grass-covered areas and cleared/paved areas associated with former buildings (Figure 5.8-1). It is enclosed by a security fence that also encompasses Line 6 and Line 7. The site currently falls within the boundary of the active 40-mm test range, which has plans to be expanded.

5.8.1.2 Operational History

Line 9 was built in 1942 and operated as percussion component production, storage, and loading facility through 1953. During this same period, Line 9 also loaded primer M54 (Tetra Tech, 2006b). Fifteen of the 38 buildings were involved in production, storage, and shipping of primers, delays, fuzes, and mines (TN & Associates, 2003b). Between 1953 and the 1960s, Line 9 was put on layaway status (TN & Associates, 2003b). From the 1960s to the early 1970s, Line 9 was used for the production of mines and mine fuses. This process included the use of Freon 113, which was stored on a concrete pad approximately 50 feet west of JAW-29. Drawings indicate the Freon tank farm was located between Buildings 9-57 and 9-59; it is estimated that there were eight 8,000-gallon Freon tanks on Line 9 (TN & Associates, 2003b). The liquid Freon was used to reduce the sensitivity of lead azide when loading, packing, and storing mines.

Two sumps at Line 9 that were located east of Building 9-57 facilitated the disposal of contaminated wastewater disposal and treatment. In 1966, a filter bed was constructed east of the sumps for the sumps to drain into (according to drawings). In 1967, the sumps were moved into the filter bed area, and effluent from the sumps was piped to the ditch east of Building 9-57 and south of the access road (Tetra Tech, 2006b). Although the nature of the water disposed of in the sumps is unknown, historical documents indicate that explosives-contaminated washdown water was transported to Line 2, where it was treated in carbon column filters (JAYCOR, 1996). During the 1980s, Line 9 operations included the Ground-emplaced Mine Scattering System and Gator projects, and Line 9 was used largely as an assembly line (URS, 2004c). Line 9 was closed sometime after 1991 (TN & Associates, 2003b); all buildings have been demolished.

5.8.1.3 Previous Investigations and Remedial Actions

Numerous investigations have been conducted at IAAAP since the 1980s. Table 5.8-1 summarizes the previous investigations and remedial actions conducted at Line 9, including conclusions and recommendations. There are no perennial surface water features within the site boundaries, but results from surface water and sediment samples collected from the intermittent features are discussed in Table 5.8-1 to support the CSM. Similarly, although soil at Line 9 has already been addressed under OU-1, previous investigations for soil are also presented in Table 5.8-1 to support the CSM.

This report summarizes the RI for groundwater at Line 9 (IAAP-010G). Previous investigations pertinent to the RI for groundwater are listed in Table 5.8-2; additional details on these investigations (e.g., including a more-detailed description of work completed, as well as work not pertinent to this RI), are included in Table 5.8-1. Previous groundwater sample locations are shown on Figure 5.8-2.

Table 5.8-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Date of Activity	Conclusion
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	1991	The principal explosives used at this facility were Composition B and PBX. It was recommended that a walk-over and field survey be conducted; if the field reconnaissance survey indicated possible past release of contaminants, then it was recommended that several monitoring wells be installed and sampled around the perimeter of Line 9 to detect possible contaminant migration.
Facility-wide Site Inspection (JAYCOR, 1992)	1991	No groundwater samples were collected during the facility-wide site inspection. it was recommended that Line 9 be further investigated during the Phase I RI.
Facility-wide Phase I RI (JAYCOR, 1993a)	1992	Groundwater samples were collected from three piezometers and analyzed for explosives. One piezometer was additionally sampled for metals. Explosives were not detected, whereas metals were detected in the one piezometer in which they were analyzed for. Further groundwater investigation was recommended to assess the VOCs identified during a soil gas survey and to determine whether groundwater had been impacted from metals contamination associated with the excavated sumps.
Follow-on RI (JAYCOR, 1996)	1993–1995	Three new monitoring wells were installed at Line 9 in 1993 and sampled for metals, SVOCs, and VOCs. Three new monitoring wells were installed in 1995 and sampled for explosives, metals, SVOCs, and VOCs. Metals were detected in all six wells. The RI report concluded that the extent of metals was localized in the surficial soils and shallow groundwater surrounding the sump at Building 9-57. One SVOC, phenanthrene, was detected in one groundwater sample. VOCs were reported in several wells. No explosives were detected in any of the monitoring wells. The report recommended that Line 9 be evaluated under the groundwater FS.
Periodic Groundwater and Surface Water Monitoring (multiple reports)	1996–2010	Groundwater samples were collected from up to seven wells during multiple sampling events between 1996 and 2010 and analyzed for VOCs, explosives, and/or natural attenuation parameters, depending on the sampling event. Pentachlorophenol regularly exceeded the MCL at one well, JAW-31. 1,1-DCE was detected at a concentration greater than its screening level once each at JAW-612 and L9-MW11. Freon 113 was regularly detected at a concentration greater than its screening level at six wells.
Supplemental Groundwater RI Report (MWH, 2001)	1997	Nine groundwater samples were collected from soil borings in the vicinity of Building 9-57 and analyzed for VOCs. Freon 113 was detected in all groundwater samples, with the greatest concentrations located east of Building 9-57. Free product (Freon 113) was indicated in the subsurface. It was not specified if free product was actually encountered or indicated based on elevated groundwater concentrations.
Line 9 Feasibility Study Data Collection and Remedial Alternatives Analysis (URS, 2004c)	2002–2003	Seventy-nine groundwater samples were collected from 39 DPT borings and analyzed for VOCs. Groundwater samples were also collected from 13 new overburden monitoring wells and sampled for explosives, VOCs, SVOCs, and natural attenuation parameters. A small explosives plume consisting primarily of RDX and HMX was observed around shallow monitoring well JAW-54. The vertical extent of the plume appeared to be restricted to the shallow aquifer zone. No metals were detected at concentrations greater than their MCLs. The primary contaminants detected in groundwater included Freon 113 and PCP. However, PCP groundwater exceedances were only observed in one well, JAW-31. Freon 113 was the most extensive contaminant at Line 9 with generally greater concentrations near the two

Table 5.8-2. Excerpts from the Previous Investigations and Remedial Actions Table for Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Investigation	Date of Activity	Conclusion
		previously excavated sumps and near the Line 9 drainage ditches. The Freon 113 plume was confined primarily to the Line 9 area, and concentrations decreased with depth. Groundwater flow and contaminant fate and transport models were developed. The models predicted that Freon 113 concentrations in groundwater should continue to decline over time due to the naturally occurring processes of dispersion and biodegradation. The initial natural attenuation evaluation indicated conditions could be favorable for degradation of Freon 113 and concentrations appeared to be slowly decreasing over time. However, the presence of potential free product could be a limiting factor.
Groundwater Treatability Study (Tetra Tech, 2008)	2005–2006	A groundwater treatability study was conducted at the south end of Line 9 to test the efficacy of enhanced in situ bioremediation at reducing the greatest concentrations of Freon 113 to levels that could be further remediated using natural attenuation. It was determined that the addition of a carbon amendment enhanced the natural degradation process of Freon 113.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	2005	The work plan concluded that groundwater, soil, surface water, and sediment had been adequately characterized and proposed no additional investigation.

Based on the results of previous investigations, soil and sump removals have been conducted and LUCs have been implemented (Leidos, 2019); excavation areas are shown on Figure 5.8-1.

The Phase 4 remedial action completion report for OU-1 soils (Shaw, 2005b) identified RDX and mercury as soil COCs. Prior to the OU-1 removal action, soil and/or sump removal actions were conducted in 1990 and 1995. The OU-1 removal action at Line 9 was conducted in 2004 and contaminated soil was excavated in accordance with the remedial action objectives established in the OU-1 ROD. Areas with elevated RDX concentrations were removed next to Building 9-57 and areas with elevated mercury concentrations were removed adjacent to Building 9-61. Confirmation sampling indicated that no soil with concentrations greater than OU-1 RGs remains; soil at Line 9 is no longer a potential source to groundwater.

As described in Section 5.8.1.2, Freon 113 and PCP have been identified as groundwater chemicals of interest in previous investigations. During the 2003 Phase 4 remedial design investigation for OU-1 (Shaw, 2004a), Freon 113 was detected in soil at levels less than its removal goal (USEPA Region 3 risk-based concentration). Therefore, it was not identified as a soil COC. Historically, the greatest Freon 113 concentrations in soil have been observed near Building 9-57 and at former sump locations (Figure 5.8-1). The greatest concentrations of Freon 113 were detected in soil during the 1997 supplemental RI at a depth of 13 feet (9,000 mg/kg); this depth is below the observed water table. PCP has not been detected in any soil samples.

Additional soil investigation was conducted at Line 9 in 2022 to determine if contaminated soil exists beneath recently demolished buildings and delineate the contamination in vadose zone soil that exceeds OU-1 RGs (TAC, 2022). The IAAAP is currently undergoing a modernization effort involving the demolition of numerous buildings throughout the Plant. The analytical results will be used to support future remedial design for soil contaminants under OU-1, and would be considered when developing the FS for OU-6, if a new soil source to groundwater was identified.

5.8.2 2018–2020 Remedial Investigation Activities

Additional field work was conducted at Line 9 to resolve data gaps needed to complete the RI for groundwater. As documented in the final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 1)* (CH2M, 2017b), PCP in groundwater was not adequately characterized around JAW-31. Furthermore, dioxins and furans may be associated with the presence of PCP due to the potential degradation products associated with PCP, and it was unknown whether these chemicals were present at Line 9. To address these data gaps, groundwater samples were collected from JAW-31 and five existing monitoring wells to the north, southwest, and southeast of JAW-31. Fieldwork completed at Line 9 was conducted in accordance with the UFP-QAPP (CH2M, 2017b) with the following data objectives:

- Initially, groundwater samples were collected from monitoring well JAW-31 (which is the only well that had detectable PCP) to confirm current concentrations and five delineation monitoring wells (L9-MW1, L9-MW2, JAW-29, JAW-30, and L9-TT-MW02) to refine the horizontal and vertical extent of PCP contamination to the north, southwest and southeast of JAW-31.

Groundwater collected at monitoring well JAW-31 was also analyzed for dioxin/furan concentrations. Because PCP was detected at three (JAW-29, L9-MW1, and L9-TT-MW02) of the other five monitoring wells listed above, those groundwater samples were also analyzed for dioxin/furan concentrations. On April 20, 2018, and April 19, 2020, six existing monitoring wells (JAW-29, JAW-30, JAW-31, L9-MW1, L9-MW2, and LL9-TT-MW02) were sampled at Line 9 (Figure 5.8-2). Groundwater samples were collected via low-flow purging and sampling techniques. All samples were analyzed for PCP by Methods SW8151A and SW8270-SIM and select wells (JAW-29, JAW-31, L9-MW1, and L9-TT-MW02) were also analyzed for dioxins and furans by Method SW8290. Purge logs are included in Appendix C. Data were managed and validated as discussed in Section 4.3. Laboratory reports are provided in Appendix B.

Groundwater elevation measurements were obtained from six existing monitoring wells on April 20, 2018. Table 5.8-3 summarizes the water-level measurements from each well at Line 9.

In 2019, four existing monitoring wells (LL9-TT-MW01 through LL9-TT-MW04) were resurveyed since top-of-casing elevation data were not available for these wells. The wells were surveyed by Bruner, Cooper, and Zuck, Inc., licensed Iowa surveyors, in accordance with Section 4.2.8. Survey information is included in Appendix E.

One existing monitoring well, L9-MW2, was redeveloped in December 2019. Its development log is provided in Appendix C.

All IDW generated during activities (purge water) was disposed of in accordance with management activities discussed in Section 4.2.9. Waste management documentation is provided in Appendix D.

5.8.3 Environmental Setting

5.8.3.1 Topography and Surface Drainage

The topography at Line 9 is relatively flat, with a slight slope toward the south and southeast. Surface drainage is via culverts and several manmade drainage ditches, which are typically shallow (2 to 4 feet deep) on the northern half of the site and increase in depth (up to 10 feet deep) on the southern half of the site. These ditches remain dry during most of the year (URS, 2004c). Surface water from the ditches converges in a ditch south of the site, which flows south into a pond. Overflow from the pond flows into an intermittent tributary through Line 7 and joins another intermittent tributary of Brush Creek approximately southeast of the site (Tetra Tech, 2006b).

5.8.3.2 Geology and Hydrogeology

The subsurface geology at Line 9 is characterized by overburden (loess underlain by till and glacial outwash) and bedrock. The loess is a silty clay/clayey silt that extends to approximately 10 feet bgs. The till is a fine- to medium-grained sandy clay with interbedded thin sand seams that are not continuous across the site. Bedrock composed of the shale and limestone of the upper Warsaw Formation is encountered at depths ranging from 64 to 98.8 feet bgs (URS, 2004c). A cross section is provided on Figure 5.8-3.

During the 2018 RI gauging event, groundwater was encountered in the overburden at depths ranging from less than 5 to 12 feet bgs (Table 5.8-3). Groundwater levels are typically higher in the spring (Tetra Tech, 2014c). Groundwater flow direction is variable at Line 9 and has ranged from the southeast to the southwest (Figure 5.8-4) and is occasionally semiradial. Horizontal hydraulic gradients are generally low, having been historically measured between 0.0065 and 0.018. A downward vertical gradient is general suggested by groundwater elevations in colocated wells (Figure 5.8-4). Based on the results of slug tests conducted at site monitoring wells, hydraulic conductivities (*K* values) range from 0.0031 to 0.84 feet/day (Tetra Tech, 2014c).

5.8.4 Nature and Extent of Contamination

This subsection describes the nature and extent of groundwater contamination at Line 9. Soil has been addressed under OU-1 but is discussed briefly to inform the CSM for a potential groundwater contaminant source. No perennial surface water or sediment is present at Line 9.

The sources of contamination at Line 9 are attributed to the historical processing of explosives, use of VOCs during site operations, and process wastewater. Explosives and chemicals handled at Line 9 included RDX, TNT, PBX, HMX, pentaerythritbl tetranitrate (PETN), lead azide, boron potassium nitrate, black powder, sodium thiosulphate, thiosulphate, antimony sulfides, Freon, PCBs, and various solvents, paints, and lacquers (TN & Associates, 2003). Although no spills were recorded at Line 9, historical releases may have occurred at two of the former sumps, which are considered the main source of the Freon 113 plume (URS, 2004c). Explosives-contaminated water from Line 9 was transported to Line 3A for treatment in carbon columns. Operations at the site ended sometime after 1991.

5.8.4.1 Groundwater

Groundwater samples have been collected at Line 9 as part of several investigations between 1992 and 2020. Fifteen shallow overburden, six intermediate overburden, and two deep overburden monitoring wells are present at Line 9 (Figure 5.8-2). Three temporary piezometers and 39 DPT borings were also used to help characterize the groundwater. Historical groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, PAHs, dioxins, explosives, and metals. However, neither pesticides, nor PCBs, nor PAHs were detected in groundwater samples. Only PCP and Freon 113 have been consistently detected at concentrations greater than SLls in groundwater samples. Based on the historical site use, COCs identified in soil, and groundwater analytical data, chemicals of interest in groundwater at Line 3 include explosives, VOCs (including Freon 113), and PCP. Explosives and VOCs are consistent with historical site operations. However, no buildings or processes were known to have used pentachlorophenol (PCP), which has been detected at a concentration greater than the screening level in one well.

During the current RI, groundwater samples were collected at Line 9 from six monitoring wells and analyzed for PCP and, in select wells, dioxins/furans (Figure 5.8-2). Table 5.8-4 presents the concentrations of chemicals detected in groundwater samples during recent groundwater sampling events (2000 through 2020). Statistical summary tables of the analytical results used in the HHRA are included in Section 5.8.6. Summary tables of all the analytical results (including nondetects) from the

2018–2020 RI activities are provided in Appendix G. Summary tables of all historical analytical results from Line 9 are provided in Appendix H.

VOCs

Twenty-one VOCs have been detected in groundwater at Line 9 (Appendix H). Between 2000 and 2008 (the last sampling event during which VOCs were analyzed for), only four VOCs (Freon 113, 1,1-DCA, 1,1-DCE, and methylene chloride) were detected at concentrations greater than their site characterization PALs (Table 5.8-4). 1,1-DCA, 1,1-DCE, and methylene chloride exceedances are limited in extent. 1,1-DCA was only detected in one groundwater sample, DPT boring L9-DP10, south of former Building 9-58. 1,1-DCE was detected at a concentration greater than its PAL in only one sample (JAW-612 in 2002); 1,1-DCE was not detected at this monitoring well during the subsequent 2003 monitoring event. Methylene chloride was detected at a concentration greater than its PAL sporadically in four monitoring wells (JAW-29, JAW-30, JAW-31, and L9-MW11) during the 2007 monitoring event (Table 5.8-4). However, most of these detections were reported with a JB qualifier, indicating that this chemical was also detected in the equipment blank sample and these concentrations are likely biased high. This argument is supported by the fact that elevated 2007 concentrations were an order of magnitude greater than the previous concentrations from the 2004 monitoring event. Given that site operations stopped sometime after 1991, there would be no site-related cause for this increase.

Three plumes of Freon 113 concentrations exceeding the PAL are present at Line 9 (Figure 5.8-5). The largest plume is present at former Building 9-57. A second smaller plume is at the location of a former substation. A third isolated plume, which is defined only by DPT boring L9-DP06, is located just north of former Building 9-59-1. In 2008, the greatest concentrations were observed at monitoring well L9-MW11, within the plume near the former substation (Table 5.8-4). Vertically, the Freon 113 plumes are delineated by deep overburden wells L9-MW2 and L9-MW13, where concentrations are over two orders of magnitude less than the site characterization PAL. Therefore, the Freon 113 plumes at Line 9 are present only in the shallow overburden aquifer, and the lateral and vertical extents of contamination are limited.

SVOCs

Twelve SVOCs have been detected in groundwater at Line 9 (Appendix H). However, the only SVOC that has been detected at a concentration greater than its site characterization PAL is PCP. Exceedances of PCP have been limited to one well, JAW-31. During the 2018–2020 RI monitoring event, PCP was not detected at a concentration greater than its PAL of 1 µg/L (Table 5.8-3).

Dioxins and Furans

Four wells (JAW-29, JAW-31, L9-MW1, and LL9-TT-MW02) were sampled for dioxins and furans during the 2018 RI sampling event. Detections were present in each well except L9-MW1. Of the 25 dioxins and furans analyzed, seven were detected (Table 5.8-4). None of the detected dioxins or furans have site characterization PALs (Appendix F. The one dioxin with a PAL (2,3,7,8-TCDD) was not detected in groundwater at Line 9 (Appendix H).

Explosives

Between 2000 and 2020, four explosives (MNX, DNX, HMX, and RDX) were detected at Line 9 (Table 5.8-4). MNX and DNX are reductive degradation products of RDX. No explosives have been detected at concentrations greater than their site characterization PALs.

Metals

Between 2000 and 2006 (the last sampling event during metals were analyzed for), five metals (calcium, iron, magnesium, manganese, and sodium) were detected at Line 9. Of these, only iron and manganese were detected at concentrations greater than their respective site characterization PALs and BTVs. These elevated concentrations of iron and manganese are not considered site-related and are attributed to the enhanced reducing conditions created by the treatability study (Tetra Tech, 2008). As described in Table 5.8-1, high-fructose corn syrup was injected in the subsurface to assess the potential for enhanced bioremediation of Freon 113 in groundwater. Analysis of iron and manganese were included in the 2005 and 2006 performance monitoring events for monitoring wells located within the treatability study boundary to help evaluate if reducing conditions were being established. The iron and manganese exceedances were observed during these 2005 and 2006 performance monitoring events. Figure 5.8-6 shows the results of the most recent (2006) metals sampling event.

Concentrations of some metals may be naturally elevated in the environment, and may not indicate a CERCLA-regulated release. Several metals (such as calcium and magnesium) were detected at Line 9 at concentrations less than their BTVs and are therefore considered to be consistent with background and naturally occurring.

5.8.5 Fate and Transport

This section discusses the fate and transport of site-related chemicals of interest at Line 9. This includes chemicals that were detected at concentrations greater than both their site characterization PAL and BTV (if available) during the last sampling event that those chemicals were analyzed. In groundwater, potential site-related chemicals of interest are PCP and VOCs, primarily Freon 113. Fate and transport characteristics for these chemicals were described in Section 6.2.

Line 9 is primarily grass covered with a few roads remaining, which lead to the cleared/paved areas associated with demolished building footprints. The IAAAP site falls within the Brush Creek and the Long Creek watersheds (Figure 2-1). Surface drainage is via culverts and several manmade drainage ditches, which are typically shallow (2 to 4 feet deep) on the northern half of the site and increase in depth (up to 10 feet deep) on the southern half of the site. These ditches remain dry during most of the year (URS, 2004c).

Contaminants have entered groundwater at Line 9 due to the historical use of Freon 113 in the production of mines and mine fuses at the site; historical releases from buildings, sumps, and tanks; and the subsequent leaching of chemicals through unsaturated zone soil. Previous investigations suggest that Freon 113 has been potentially present as nonaqueous phase liquid in the saturated zone in borings from the northeast corner of the conveyor at Building 9-57 and east of the building at depths between 15 and 30 feet bgs (Tetra Tech, 2006b). Bedrock is relatively deep at Line 9 and has been encountered between approximately 64 and 99 feet bgs. The groundwater table at Line 9 is shallow, and groundwater in the overburden aquifer was encountered between 4 and 12 feet bgs during the current RI.

Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Given that the overburden aquifer is composed predominantly of clays and that the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow. However, the velocity may be faster within the sand seams present with the aquifer.

Natural attenuation mechanisms that are potentially active at Line 9 were evaluated. Natural attenuation includes various physical, chemical, or biological processes that under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. A weight-of-evidence approach was used for this evaluation.

- The primary line of evidence that attenuation is occurring at a site is reduction over time in contaminant concentrations or mass or both.
  - PCP has been detected at a concentration greater than its site characterization PAL in only one shallow overburden monitoring well at Line 9 (JAW-31). PCP concentrations that were detected at levels greater than the site characterization PAL were plotted over time for monitoring well JAW-31 (Figure 5.8-7). As shown on the trend graph, PCP concentrations have fluctuated over

time at relatively low levels. No discernable trend is apparent; however, recent concentrations appear relatively stable or decreasing. PCP has not been detected in soil at Line 9, and therefore there is no continuing source to groundwater.

  - Freon 113 concentrations were plotted for seven monitoring wells that have shown exceedances (Figure 5.8-7). Concentrations at monitoring well JAW-31 have fluctuated over time. However, trend graphs for the other six wells are more suggestive of increasing trends. Although Freon 113 was not detected in soil at concentrations greater than removal goals, concentrations did exceed conservative leachability SLs. Plus, previous saturated soil data have suggested that nonaqueous phase liquid may be present. This information suggests there may be a continuing source to groundwater.
  - Three other VOCs (1-DCA, 1,1-DCE, and methylene chloride) have also been detected at concentrations greater than their site characterization PALs. However, these VOC exceedances are limited in extent, which may indicate they are subject to attenuation. 1,1-DCA was only detected in one groundwater sample, DPT boring L9-DP10. 1,1-DCE was detected at a concentration greater than its PAL in only one sample (JAW-612 in 2002); 1,1-DCE was not detected at this monitoring well during the subsequent 2003 monitoring event. Methylene chloride was detected at concentrations greater than its PAL sporadically in four monitoring wells (JAW-29, JAW-30, JAW-31, and L9-MW11) during the 2007 monitoring event (Table 5.8-4). However, most of these detections were reported with a JB qualifier, indicating that this chemical was also detected in the equipment blank sample and these concentrations are likely biased high.

- Water quality parameters can be used to evaluate whether the geochemical conditions are conducive to biodegradation. During the current RI, groundwater in the impacted monitoring wells was observed to be under aerobic and oxidizing conditions. DO concentrations in groundwater were reported at levels greater than 1 mg/L, and ORP values greater than +100 mV were reported (Table 5.8-5). The historical lack of nitrite and sulfide in groundwater samples may also be indicative of more oxidizing, as opposed to reducing, conditions. pH values were relatively neutral (between 6 and 7), which is favorable for biological activity. Under these geochemical conditions, aerobic degradation of Freon 113 and PCP would be favorable. However, Freon 113 has shown to be persistent in groundwater (U.S. National Library of Medicine, 2015).
- The physical natural attenuation processes are also likely helping to stabilize the plumes, given their very limited extent based on historical concentration data (Table 5.8-4). Both PCP and Freon 113 have moderate water solubilities and moderately low sorption potentials (Table 4.2-1). Therefore, they can be mobile but should be retarded somewhat as they sorb to the clay geology. The other VOCs of interest have high water solubilities and low sorption potential, which are indicative of greater mobility. But, as previously discussed, these VOCs have a very limited event in groundwater. PCP has a relatively low vapor pressure, while the VOCs have a high vapor pressure. Therefore, the VOCs may volatilize into soil gas at the interface with the water table.

5.8.6 Human Health Risk Assessment

An HHRA was prepared for Line 9 to evaluate potential current and future health risks and hazards from exposure to chemicals in site groundwater. Soil media is not included in the HHRA, as soil is not a component of this RI; the soil RI was conducted under OU-1. As discussed in Section 5.8.1.3, contaminants in soil were removed to meet their OU-1 RGs under multiple removal actions. Therefore, soil sources to groundwater have been removed. Surface water and sediment media are not included in the HHRA because perennial surface water features are not present at Line 9. The HHRA was conducted in accordance with the final UFP-QAPP (CH2M, 2017a), with the exception of some deviations that were agreed to during meetings or correspondence with USACE and USEPA following approval of the final

UFP-QAPP. The approach and method used to conduct the HHRA are provided in Section 4.3.1. This section presents the CEM for Line 9 and provides the results of the four-step evaluation process composed of:

- Data evaluation.
- Exposure assessment.
- Toxicity assessment.
- Risk characterization.

The results of the HHRA are used to determine whether further action is warranted for groundwater at Line 9.

5.8.6.1 Conceptual Exposure Model

A description of Line 9, its operational history, previous investigations, and remedial actions are provided in Sections 5.8.1 and 5.8.2. The soil at Line 9 is addressed under the remedy for OU-1 (IAAAP Site IAAP-005) (Leidos, 2018) and was not reevaluated in this HHRA.

The site was used for production, shipping, and storage of munitions. Line 9 is primarily grass covered with a few roads remaining, which lead to the cleared/paved areas associated with demolished building footprints. There are no buildings or perennial surface water features within the Line 9 site boundary. The site is closed to recreational activities; therefore, hunting is not permitted within the site boundary. There are no potential receptors or potentially complete exposure pathways identified under current site conditions. It is assumed the site could become active or redeveloped in the future. Culverts are present at the site; therefore, potential groundwater exposures by future construction/utility workers are complete at Line 9.

Groundwater is not currently being used as a potable water source, and there are no plans to use groundwater for potable purposes in the future; however, based on applicable CERCLA policy and guidance, groundwater at Line 9 is classified as Class IIB, a potential source of drinking water (USEPA, 1989). Therefore, the HHRA for Line 9 evaluates potential exposures to groundwater due to its potential future use as a drinking water source. This consists of the evaluation of future residential exposures to groundwater.

The following potential future human receptors were identified in the HHRA for Line 9:

- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 9. If buildings are constructed onsite, future site workers could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in future buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within Line 9.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 9 and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in future buildings.

As discussed in Section 4.3.1, potential exposures and risks and hazards to future site workers and construction/utility workers are estimated in the HHRA only if the estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk levels and COCs are identified for a residential scenario. The human health CEM presenting potential exposure media, exposure points, receptors (future), and exposure routes is provided in Appendix A-9 Attachment 1 (Table 1) and depicted graphically on Figure 5.8-8.

5.8.6.2 Data Evaluation

Data Used in the HHRA

The analytical data used in the HHRA consisted of groundwater samples collected at Line 9. Historical groundwater samples collected from 2003–2008, 2010 and recent samples collected in 2018, 2019, and 2020 were used in the HHRA for Line 9. Historical groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, PAHs, dioxins, explosives, and metals. However, neither pesticides, nor PCBs, nor PAHs were detected in groundwater samples. The analytical data for SVOCs and VOCs from 2003 were not included in the HHRA because SVOC and VOC data were available from more recent sampling events. Iron and manganese were the only metals analyzed in the dataset selected for HHRA, but they were not evaluated in the HHRA because their presence in groundwater is likely associated with a treatability study that was conducted at the south end of Line 9 to test the efficacy of enhanced in situ bioremediation at reducing concentrations of 1,1,2-trichlorotrifluoroethane (Freon 113) (Tetra Tech, 2008). A summary of the treatability study is provided in Table 5.8-1 and Section 5.8.4. Only PCP and Freon 113 have been consistently detected at concentrations greater than SLs in groundwater samples and are considered the primary chemicals of interest. These chemicals are consistent with historical site operations. As stated in the UFP-QAPP (CH2M, 2017a), “Older data (i.e., data collected prior to 2012) may be used in the human health risk assessments if they are still representative of the site (i.e., groundwater flow is slow), chemicals have properties where there would not be a significant reduction in concentrations over time (e.g., metals), or data are conservative for site conditions.” Line 9 is no longer operational, as described in Section 5.8.1. Potential soil sources to groundwater have been remediated, as described in Section 5.8.1.3. Due to a lack of continuing sources, historical concentrations in groundwater are expected to have remained stable or even decreased due to natural attenuation processes. Therefore, the assumptions in the final UFP-QAPP still hold. Samples collected prior to 2012 are considered representative of, or more conservative than, current conditions at Line 9.

Eighty-four groundwater samples were used to evaluate potential exposures for both a potable use scenario and the VI pathway. The groundwater samples were not collected at multilevel wells; therefore, a separate data grouping (based on shallow groundwater only) was not used to evaluate the VI pathway. A separate groundwater data grouping was used to evaluate a construction/utility worker scenario, assuming construction/utility workers could be exposed to groundwater encountered at depths up to 10 feet bgs. Twenty-three groundwater samples were used to evaluate potential exposures in a trench for a construction/utility worker.

Table 5.8-6 lists the number of chemicals analyzed and detected in groundwater at Line 9:

Table 5.8-6. Chemical Groups Analyzed in HHRA Data
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical Group	Number of Chemicals Analyzed	Number of Chemicals Detected
Groundwater		
Explosives	16	4
Dioxins	17	6
SVOCs	49	4
VOCs	44	9

A description of the data groupings and samples included in the HHRA are provided in Tables 5.8-7 and 5.8-8, respectively. The analytical data set used in the HHRA is included as Appendix A-9, Attachment 2.

The groundwater sampling locations included in the HHRA and the delineations of the Freon 113 plumes are depicted on Figures 5.8-8 and 5.8-4, respectively.

Screening Results for Site-related Chemicals of Potential Concern and Naturally Occurring Chemicals

The approach and SLs used to select the COPCs (site-related COPCs or naturally occurring chemicals) are described in Section 4.3.1. The results of the COPC screening process for a future hypothetical resident potentially exposed to groundwater are provided in Appendix A-9, Attachment 1 (Tables 2.1 through 2.3). As summarized below, dioxins, one SVOC, and four VOCs were identified as COPCs (site-related COPCs or naturally occurring chemicals) in groundwater for a potable use scenario. Three VOCs were identified as COPCs in groundwater for vapor intrusion. Dioxins, one SVOC, and two VOCs were identified as COPCs in groundwater for a construction worker scenario. As indicated previously, metals (specifically iron and manganese) were not evaluated in the HHRA because their presence in groundwater is likely associated with a treatability study that was conducted at the south end of Line 9. The COPCs (site-related COPCs or naturally occurring chemicals) are addressed further in the HHRA, and potential exposures and risks and hazards were estimated for each COPC (site-related COPC or naturally occurring chemical).

The 2,3,7,8-TCDD TEQ concentrations for the dioxin/furan congeners were calculated as described in Section 4.3.1.4. The TEFs used to calculate the dioxin TEQ concentrations and the dioxin TEQ concentration calculations are shown in Appendix A-9, Attachment 1 (Table 2 Supplement A) (Table 5.8-9).

Table 5.8-9. Summary of COPCs for Line 9—Site-Related[a]
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Groundwater Used for Tap Water				
Future Site Worker and Future Hypothetical Resident	Total 2,3,7,8-TCDD TEQ	3/4	5E-08	2E-07
	Pentachlorophenol	6/14	0.27	12
	1,1,2-Trichlorotrifluoroethane (Freon 113)	57/57	5.5	808000
	1,1-Dichloroethene	1/11	535	535
	Acetone	1/11	2800	2800
	Methylene chloride	4/11	149	7060
Groundwater to Indoor Air via Vapor Intrusion				
Future Site Worker and Future Hypothetical Resident	1,1,2-Trichlorotrifluoroethane (Freon 113)	57/57	5.5	808000
	1,1-Dichloroethene	1/11	535	535
	Methylene chloride	4/11	149	7060

Table 5.8-9. Summary of COPCs for Line 9—Site-Related[a]
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor	COPC	Frequency of Detections	Minimum Detection (µg/L)	Maximum Detection (µg/L)
Shallow Groundwater in a Trench (<10 ft bgs)				
Future Construction/Utility Worker	Total 2,3,7,8-TCDD TEQ	3/3	5E-08	2E-07
	Pentachlorophenol	5/10	0.4	12
	1,1,2-Trichlorotrifluoroethane (Freon 113)	15/15	1430	808000
	Methylene chloride	3/6	1360	7060

[a] No COPCs at the Line 9 are naturally occurring.

5.8.6.3 Exposure Assessment

Line 9 is currently inactive, and former buildings have been demolished. However, the active 40-mm test range that contains Line 9 within its boundary will be expanded. Additionally, the site is closed to recreational activities, and hunting is not permitted within the site boundary. There are no potentially complete exposure pathways identified under current site conditions. As previously discussed, groundwater is not currently being used as a potable water source; however, the HHRA for Line 9 evaluated potential exposures to groundwater due to its potential future use as a drinking water source. This consists of evaluating future residential exposures to groundwater. Therefore, ingestion and dermal contact exposures to COPCs in groundwater were estimated for future site workers and hypothetical residents. Additionally, inhalation exposures to site groundwater were also evaluated for hypothetical residents, assuming VOCs could be present in household air as a result of showering, bathing, and other household activities. The vapor intrusion pathway is also considered potentially complete for groundwater if future industrial buildings or residences are constructed at Line 9; therefore, potential inhalation exposures to indoor air were evaluated for site workers and hypothetical residents. Culverts are located at Line 9; therefore, potential ingestion, dermal contact, and inhalation exposures to shallow groundwater in a trench were evaluated for future construction/utility workers. The potential exposure pathways quantified in the HHRA are included in Appendix A-9, Attachment 1 (Table 1) and on Figure 5.8-8. The following receptor scenarios were quantified in the HHRA for Line 9:

- Future site worker.
  - Groundwater (tap water) COPCs—ingestion and dermal contact.
  - Groundwater (vapor intrusion) COPCs—inhalation of volatiles in indoor air.
- Future construction/utility worker.
  - Shallow groundwater (trench, 0 to 10 feet bgs) COPCs—incidental ingestion, dermal contact and inhalation of volatiles.
- Future hypothetical residents (adult and child).
  - Groundwater (tap water) COPCs—ingestion, dermal contact, and inhalation of volatiles in household air.
  - Groundwater (vapor intrusion) COPCs—inhalation of volatiles in indoor air.

Risks and hazards for site workers and construction/utility workers were quantified in the HHRA because the estimated risks or hazards for a hypothetical residential scenario exceeded acceptable risk or hazard levels and COCs were identified for a residential scenario.

In accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (USEPA, 2014b), groundwater EPCs are typically calculated based on the data collected in the core of a plume. Three Freon 113 plumes are present at Line 9, a north plume, a middle plume, and a south plume (Figure 5.8-5). Fifteen groundwater samples are available in the HHRA dataset for the north plume area, and 47 groundwater samples are available for the south plume area. Fifteen shallow groundwater samples are available for the north plume area and eight shallow groundwater samples are available for the south plume area. No samples used in the HHRA dataset were from the middle plume; one historical sample was collected in 2002 from the middle plume, however, SVOC and VOC data for the site were available from more recent sampling events. The greatest concentrations of Freon 113 were detected in the north and south plumes.

Three monitoring wells are located within the core of the north plume: JAW-29, JAW-30, and JAW-31. Six monitoring wells are located within the core of the south plume: L9-MW11, L9-MW12, L9-MW-13, LL9-TT-MW02, LL9-TT-MW03, and LL9-TT-MW04. One COPC (Freon 113) had at least four detected concentrations and eight samples available in the north and south groundwater plume datasets; therefore, the UCL was calculated for this COPC using USEPA's ProUCL software (USEPA, 2016), and the UCLs were selected as the EPCs. For the other five COPCs (total 2,3,7,8-TCDD TEQ, PCP, 1,1-DCE, acetone, and methylene chloride), the MDC from the two plumes was selected as the EPC because fewer than four detected concentrations were available in the groundwater dataset and a reliable UCL could not be estimated due to the limited number of detected concentrations. The groundwater EPCs used to estimate the chemical daily intakes and ECs for each receptor scenario are provided in Appendix A-9, Attachment 1 (Tables 3.1 [north plume, potable], Table 3.2 [north plume, VI], Table 3.3 [south plume, potable], Table 3.4 [south plume, VI], Table 3.5 [north plume, shallow groundwater in a trench], and Table 3.6 [south plume, shallow groundwater in a trench]). Since future receptors were assumed to have potential exposure to groundwater from both plumes, the greatest EPC of the two plumes was selected as the final EPC for each COPC, as provided in Appendix A-9, Attachment 1 (Table 3.3 Supplement A [potable], Table 3.4 Supplement A [VI], Table 3.6 Supplement A [shallow groundwater in a trench], and Table 3.6 Supplement B [trench air]). The ProUCL output for the COPCs is provided in Appendix A-9, Attachment 3.

The exposure factors used in the daily intake and EC calculations for future receptor scenarios are included in Appendix A-9, Attachment 1 (Tables 4.1 through 4.5). The primary references for the exposure factor values are the standard default exposure factors presented in the HHEM *Update of Standard Default Exposure Factors* (USEPA, 2014a).

One COPC (methylene chloride) was identified as acting with an MMOA in site media. The ADAFs and exposure assumptions used to calculate adjusted daily intakes and ECs for methylene chloride are provided in Appendix A-9, Attachment 1 (Table 4 Supplement A).

5.8.6.4 Toxicity Assessment

The oral toxicity values (CSFs and RfDs) and inhalation toxicity values (IURs and RfCs) used in the HHRA were obtained from the USEPA standard hierarchy of toxicity value sources (USEPA, 2003b), as provided in Section 4.3.1. Noncancer toxicity values for the COPCs identified at Line 9 are provided in Appendix A-8, Attachment 1 (Tables 5.1 and 5.2). Cancer toxicity values for the COPCs are provided in Appendix A-8, Attachment 1 (Tables 6.1 and 6.2).

5.8.6.5 Risk Characterization

The risk characterization for Line 9 was completed using a four-step process, as discussed in Section 4.3.1. The results of each step are discussed below.

Step 1: Total Combined Risks and Hazards from Site-related COPCs and Naturally Occurring Chemicals

Step 1 consists of calculating receptor-specific ELCRs and HIs that include contributions from both site-related COPCs and naturally occurring chemicals. The estimated risks and hazards for a hypothetical residential scenario are summarized in Table 5.8-10.

Table 5.8-10. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 9		
				EPC [b]	ELCR	HI
Hypothetical Resident (Adult)	7.1 and 9.1	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	6310000	NA	1210
			1,1-Dichloroethene	380	NA	2
			Methylene chloride	598	NA	1
			Total HI (Groundwater—Indoor Air):		**NA**	**1213**
		Groundwater (Tap water)	Total 2,3,7,8-TCDD TEQ	2.03E-07	NA	0.3
			Pentachlorophenol	6	NA	0.2
			1,1,2-Trichlorotrifluoroethane (Freon 113)	462456	NA	45
			1,1-Dichloroethene	535	NA	2
			Acetone	2800	NA	0.09
			Methylene chloride	7060	NA	42
	Total HI (Groundwater—Tap Water):				**NA**	**89**
	Total HI (Groundwater—Indoor Air and Tap Water):				**NA**	**1302**
Hypothetical Resident (Child)	7.2 and 9.2	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	6310000	NA	1210
			1,1-Dichloroethene	380	NA	2
			Methylene chloride	598	NA	1
			Total HI (Groundwater—Indoor Air):		**NA**	**1213**
		Groundwater (Tap water)	Total 2,3,7,8-TCDD TEQ	2.03E-07	NA	0.5
			Pentachlorophenol	6	NA	0.3
			1,1,2-Trichlorotrifluoroethane (Freon 113)	462456	NA	45
			1,1-Dichloroethene	535	NA	2
			Acetone	2800	NA	0.2
			Methylene chloride	7060	NA	66

Table 5.8-10. Summary of Total Combined Risk and Hazard Estimates for Site-Related COPCs and Naturally Occurring Chemicals—Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-4, Attachment 1	Exposure Medium	COPC/Chemical	Line 9		
				EPC [b]	ELCR	HI
				Total HI (Groundwater—Tap Water):	**NA**	**114**
				Total HI (Groundwater—Indoor Air and Tap Water):	**NA**	**1327**
Hypothetical Resident (Adult/Child Aggregate)	7.3 and 9.3	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	6310000	NA	NA
			1,1-Dichloroethene	380	NA	NA
			Methylene chloride	598	6E-06	NA
			Total ELCR (Groundwater—Indoor Air):		**6E-06**	**NA**
		Groundwater (Tap water)	Total 2,3,7,8-TCDD TEQ	2.03E-07	1E-05	NA
			Pentachlorophenol	6	2E-04	NA
			1,1,2-Trichlorotrifluoroethane (Freon 113)	462456	NA	NA
			1,1-Dichloroethene	535	NA	NA
			Acetone	2800	NA	NA
			Methylene chloride	7060	6E-04	NA
				Total ELCR (Groundwater—Tap Water):	**8E-04**	**NA**
				Total ELCR (Groundwater—Indoor Air and Tap Water):	**8E-04**	NA

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (indoor air) - µg/m³, groundwater (tap water)—micrograms per liter.

NA = not applicable

RME = reasonable maximum exposure

Step 2: Risk Characterization of Naturally Occurring Chemicals

Step 2 consists of calculating receptor-specific ELCRs and HIs for naturally occurring chemicals. Site groundwater was not analyzed for metals in the most recent sampling events; therefore, no naturally occurring chemicals were identified in groundwater at Line 9. However, historical detections of metals in groundwater were limited, as discussed in Section 5.8.4.

Step 3: Risk Characterization of Site-Related COPCs

Step 3 consists of calculating receptor-specific ELCRs and HIs associated with site-related COPCs. All six COPCs evaluated in Step 1 were identified as site-related COPCs for groundwater at Line 9. The estimated risks and hazards for COPCs in groundwater for a future site worker, construction/utility worker, and hypothetical resident are provided in Table 5.8-11; estimated risks and hazards for COPCs in groundwater for hypothetical residents are the same as those summarized in Table 5.8-10.

Table 5.8-11. Summary of Risk and Hazard Estimates for Site-Related COPCs— Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	COPC	Line 9		
				EPC [b]	ELCR	HI
Site Worker	7.4 and 9.4	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	6310000	NA	288
			1,1-Dichloroethene	380	NA	0.4
			Methylene chloride	598	5E-07	0.2
			Total ELCR and HI (Groundwater—Indoor Air):		**5E-07**	**289[c]**
		Groundwater (Tap water)	Total 2,3,7,8-TCDD TEQ	2.03E-07	6E-07	0.02
			Pentachlorophenol	6	1E-05	0.02
			1,1,2-Trichlorotrifluoroethane (Freon 113)	462456	NA	0.1
			1,1-Dichloroethene	535	NA	0.09
			Acetone	2800	NA	0.03
			Methylene chloride	7060	4E-05	10
			Total ELCR and HI (Groundwater—Tap Water):		**6E-05**	**10[d]**
	Total ELCR and HI (Groundwater—Indoor Air and Tap Water):				**6E-05**	**299[e]**
Construction/Utility Worker	7.5 and 9.5	Shallow Groundwater (Trench)	Total 2,3,7,8-TCDD TEQ	2.03E-07	7E-09	0.005
			Pentachlorophenol	6	7E-08	0.3
			1,1,2-Trichlorotrifluoroethane (Freon 113)	462456	NA	0.03
			Methylene chloride	7060	4E-08	0.03
			Total ELCR and HI (Shallow Groundwater—Trench):		**1E-07**	**0.4**
		Trench Air	Total 2,3,7,8-TCDD TEQ	4.77E-07	9E-09	0.01
			1,1,2-Trichlorotrifluoroethane (Freon 113)	2783358	NA	48
			Methylene chloride	61981	2E-06	14
			Total ELCR and HI (Shallow Groundwater—Trench Air):		**2E-06**	**61[f]**

Table 5.8-11. Summary of Risk and Hazard Estimates for Site-Related COPCs— Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	COPC	Line 9		
				EPC [b]	ELCR	HI
			Total ELCR and HI (Shallow Groundwater—Groundwater and Trench Air):		**2E-06**	**62[f]**
Hypothetical Resident (Adult)	7.6 and 9.6	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	6310000	NA	1210
			1,1-Dichloroethene	380	NA	2
			Methylene chloride	598	NA	1
			Total HI (Groundwater—Indoor Air):		**NA**	**1213[e]**
		Groundwater (Tap water)	Total 2,3,7,8-TCDD TEQ	2.03E-07	NA	0.3
			Pentachlorophenol	6	NA	0.2
			1,1,2-Trichlorotrifluoroethane (Freon 113)	462456	NA	45
			1,1-Dichloroethene	535	NA	2
			Acetone	2800	NA	0.09
			Methylene chloride	7060	NA	42
	Total HI (Groundwater—Tap Water):				**NA**	**89[g]**
	Total HI (Groundwater—Indoor Air and Tap Water):				**NA**	**1302[g]**
Hypothetical Resident (Child)	7.7 and 9.7	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	6310000	NA	1210
			1,1-Dichloroethene	380	NA	2
			Methylene chloride	598	NA	1
			Total HI (Groundwater—Indoor Air):		**NA**	**1213[e]**
		Groundwater (Tap water)	Total 2,3,7,8-TCDD TEQ	2.03E-07	NA	0.5
			Pentachlorophenol	6	NA	0.3
			1,1,2-Trichlorotrifluoroethane (Freon 113)	462456	NA	45
			1,1-Dichloroethene	535	NA	2
			Acetone	2800	NA	0.2

Table 5.8-11. Summary of Risk and Hazard Estimates for Site-Related COPCs— Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Receptor [a]	ELCR/HI Tables (RME) in Appendix A-5, Attachment 1	Exposure Medium	COPC	Line 9		
				EPC [b]	ELCR	HI
			Methylene chloride	7060	NA	66
	Total HI (Groundwater—Tap Water):				**NA**	**114[g]**
	Total HI (Groundwater—Indoor Air and Tap Water):				**NA**	**1327[g]**
Hypothetical Resident (Adult/Child Aggregate)	7.8 and 9.8	Groundwater (Indoor Air)	1,1,2-Trichlorotrifluoroethane (Freon 113)	6310000	NA	NA
			1,1-Dichloroethene	380	NA	NA
			Methylene chloride	598	6E-06	NA
			Total ELCR (Groundwater—Indoor Air):		**6E-06**	**NA**
		Groundwater (Tap water)	Total 2,3,7,8-TCDD TEQ	2.03E-07	1E-05	NA
			Pentachlorophenol	6	2E-04	NA
			1,1,2-Trichlorotrifluoroethane (Freon 113)	462456	NA	NA
			1,1-Dichloroethene	535	NA	NA
			Acetone	2800	NA	NA
			Methylene chloride	7060	6E-04	NA
	Total ELCR (Groundwater—Tap Water):				**8E-04[h]**	**NA**
	Total ELCR (Groundwater—Indoor Air and Tap Water):				**8E-04[h]**	**NA**

Notes:

[a] ELCRs were estimated for the adult/child aggregate receptor based on lifetime exposure and noncarcinogenic HIs were estimated separately for adult and child residents.

[b] EPC Units: groundwater (indoor air) - µg/m^3, groundwater (tap water)—micrograms per liter.

[c] The HI for NOE (due to 1,1,2-trichlorotrifluoroethane [Freon 113]) exceeds 1—Appendix A-4, Attachment 1 (see Table 9.4).

[d] The HI for hepatic (due to methylene chloride) exceeds 1—Appendix a-4, Attachment 1 (see Table 9.4).

[e] The HIs for NOE (due to 1,1,2-trichlorotrifluoroethane [Freon 113]) and hepatic (due to 1,1-DCE and methylene chloride) exceed 1—Appendix A-4, Attachment 1 (see Tables 9.4, 9.6, and 9.7).

[f] The HIs for NOE (due to 1,1,2-trichlorotrifluoroethane [Freon 113]) and/or hepatic (due to methylene chloride) exceed 1—Appendix a-4, Attachment 1 (see Table 9.5).

[g] The HIs for NOE (due to 1,1,2-trichlorotrifluoroethane [Freon 113]) and/or hepatic (due to pentachlorophenol; 1,1-dichloroethene; and methylene chloride) exceed 1—Appendix A-4, Attachment 1 (see Tables 9.6 and 9.7).

[h] The ELCR exceeds 1×10^{-4} (due to Total 2,3,7,8-TCDD TEQ, pentachlorophenol, and methylene chloride)—Appendix A-4, Attachment 1 (see Table 9.8).

NA = not applicable

RME = reasonable maximum exposure

Step 4: Final COC Determination

Potential exposures and risks and hazards were estimated for future site workers, construction/utility workers, and hypothetical residents at Line 9, and exceedances of USEPA's acceptable HI and ELCR are indicated in Table 5.8-12:

Table 5.8-12. COPCs Exceeding USEPA's Risk and Hazard Target Thresholds
Iowa Army Ammunition Plant, Middletown, Iowa

Groundwater Exposure Pathway	Receptor	Chemicals Causing Receptor Target Organ HI > 1	Chemicals Causing Receptor ELCR > 1 × 10^{-4}
Potable use	Hypothetical residents	PCP, 1,1-DCE, methylene chloride, Freon 113	Total 2,3,7,8-TCDD TEQ, PCP, methylene chloride
Indoor air (VI)		1,1-DCE, methylene chloride, Freon 113	Methylene chloride
Potable use	Site workers	Methylene chloride	—
Indoor air (VI)		1,1-DCE, methylene chloride, Freon 113	—
Trench air	Construction/ utility workers	Methylene chloride, Freon 113	—

The federal MCLs for 2,3,7,8-TCDD TEQ, PCP, Freon 113, 1,1-DCE, and methylene chloride are presented in Table 5.8-13:

Table 5.8-13. Comparison of COC Concentrations to MCLs
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical	MDC (µg/L)	MCL (µg/L)	Exceeds MCL?	Groundwater COC for Hypothetical Residential Scenario?
Total 2,3,7,8-TCDD TEQ	0.00000020337	0.00003	No	No
Pentachlorophenol	12	1	Yes	Yes
1,1,2-Trichlorotrifluoroethane (Freon 113)	808,000	NA	NA	Yes
1,1-DCE	535	7	Yes	Yes
Methylene chloride	7,060	5	Yes	No (see below)

Total 2,3,7,8-TCDD TEQ was detected at concentrations less than the MCL; therefore, it was not identified as a COC in groundwater at Line 9. Methylene chloride was detected at a maximum concentration greater than the MCL; however, methylene chloride is a common laboratory contaminant, and it is not considered to be associated with a CERCLA release at the site. Three of the four detected concentrations in groundwater are B-qualified; therefore, methylene chloride was not identified as a COC in groundwater at Line 9. In summary, the following COCs were identified for groundwater, as presented in Appendix A-9, Attachment 1 tables:

Final COCs identified for Groundwater at Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Future Receptor	Freon	PCP	1,1-DCE	Appendix A-9, Attachment 1 Table #
Site Workers	X	—	—	10.1
Construction/Utility Workers	X	—	—	10.2
Hypothetical Residents	X	X	X	10.3 to 10.5

5.8.6.6 Uncertainty Analysis

The assumptions used in the HHRAs have inherent uncertainty. The general uncertainties associated with the HHRAs for the sites in this RI report are provided in Section 4.3.1. This section provides additional site-specific uncertainties associated with the HHRA for Line 9 that are not included in Section 4.3.1.

Chemicals that were 100 percent not detected in an exposure medium were not included in the COPC identification process; however, they were evaluated in a separate screening to determine whether elevated nondetected results were present in site media. The detailed analysis of the nondetected chemicals at Line 9 is provided in Appendix A-9, Attachment 4. In summary, four explosives (2,4-DNT, 2,6-DNT, 2-nitrotoluene and nitrobenzene), 14 SVOCs, and 33 VOCs have RLs/DLs exceeding SLs. Although the RLs and DLs for these nondetect chemicals are greater than the SLs, based on the age of the data, laboratory limitations, chemical interferences from detected Freon 113 concentrations and comparison to historically detected chemicals in groundwater at IAAAP, further consideration of nondetect chemicals does not appear warranted in the Line 9 HHRA.

5.8.6.7 Summary of HHRA

An HHRA was prepared for Line 9 to evaluate potential current and future health risks from exposure to chemicals in site groundwater. Line 9 is currently inactive and former buildings have been demolished. Additionally, the site is closed to recreational activities and hunting is not permitted within the site boundary. There are no potential receptors or potentially complete exposure pathways identified for Line 9 under current site conditions.

The following potential future human receptors were identified in the HHRA for Line 9:

- **Future Site Workers.** Future site workers could contact groundwater based on potential future use as a drinking water source at Line 9. If buildings are constructed onsite, future site workers could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in those future buildings.
- **Future Construction/Utility Workers.** Future construction/utility workers could contact shallow groundwater while replacing a culvert located within the Line 9 site.
- **Future Hypothetical Residents.** Future hypothetical residents could contact groundwater based on potential future use as a drinking water source at Line 9 and could be exposed to indoor air (that may be impacted by VOCs migrating from groundwater) in future buildings.

Potential exposures and risks and hazards to future site workers and construction/utility workers were estimated in the HHRA since estimated risks and hazards for a hypothetical residential scenario exceed acceptable risk and hazard levels and COCs were identified for a residential scenario.

The COPCs (site-related COPCs or naturally occurring chemicals) identified in site groundwater are as follows:

- Groundwater (potable use):

  - Naturally occurring: none.
  - Site-related: total 2,3,7,8-TCDD TEQ, PCP, Freon 113, 1,1-DCE, and acetone.
- Groundwater (vapor intrusion):
  - Naturally occurring: none.
  - Site-related: Freon 113, 1,1-DCE.
- Groundwater (trench scenario):
  - Naturally occurring: none.
  - Site-related: total 2,3,7,8-TCDD TEQ, PCP, Freon 113.

The risk characterization for Line 9 was completed using a four-step process, as discussed in Section 4.3.1. Step 1 presents the total combined risks and hazards from site-related COPCs and naturally occurring chemicals, as summarized in Table 5.8-10. Step 2 presents the risks and hazards from naturally occurring chemicals; however, no naturally occurring chemicals were identified in groundwater at Line 9. Step 3 presents the risks and hazards from site-related COPCs, as summarized in Table 5.8-11.

Unacceptable groundwater risks and hazards were identified for site workers, construction/utility workers, and hypothetical residents. Freon 113 and 1,1-DCE were identified as COCs for future site workers; Freon 113 was identified as a COC for future construction/utility workers; and Freon 113, 1,1-DCE, and PCP were identified as COCs for future hypothetical residents. Total 2,3,7,8-TCDD TEQ was not identified as a COC in groundwater since it was detected at concentrations less than the MCL.

In summary, the following COCs were identified for groundwater (Table 5.8-14):

Table 5.8-14. Final COCs for Line 9 Groundwater
Iowa Army Ammunition Plant, Middletown, Iowa

Future Site Worker	Future Construction/Utility Worker	Future Hypothetical Resident
Freon 113 1,1-DCE	Freon 113	Freon 113 1,1-DCE PCP

5.8.7 Ecological Risk Assessment

The ERA for groundwater at Line 9 is presented herein, beginning with Step 1 of the ERA process (to determine whether there are complete exposure pathways). Soil at Line 9 is already addressed under the remedy for OU-1. There are no perennial surface water features within the Line 9 boundary, so as a result there are no complete exposure pathways for sediment or surface water. A summary of the Line 9 relationship with the Brush Creek watershed is discussed in the watershed ERA (CH2M, 2022) and included in Appendix I.

Groundwater is present onsite, but ecological receptors are not exposed directly to groundwater; however, groundwater is a transport medium, and contaminated groundwater has the potential to migrate to and discharge to surface water bodies. Although there are ditches onsite for drainage purposes, these are not perennial water bodies and do not provide suitable habitat for ecological receptors. Given the lack of perennial surface water bodies on Line 9, the groundwater-to-surface-water exposure pathway is incomplete. Since there are no complete exposure pathways for ecological receptors, no adverse effects are expected. No additional remedial actions are required to address ecological effects.

5.8.8 Conclusions and Recommendations

An RI was conducted for Line 9 to refine the nature and extent of contamination in groundwater from historical activities and assess for potential unacceptable risk to human health and the environment. Soil at this site was addressed under the remedial action for OU-1 and is not covered under this RI for OU-6. There are no perennial surface water features within the Line 9 boundary. Analytical data available for groundwater at Line 9 includes VOCs, SVOCs, pesticides, PCBs, PAHs, dioxins, explosives, and metals. Of these, only explosives, VOCs, and SVOCs were identified as site-related chemicals of interest based on historical site operations and a comparison of concentration data to site characterization PALs (listed in Appendix F) and BTVs. Iron and manganese PAL exceedances are not considered site-related and are attributed to the enhanced reducing conditions created by the treatability study (Tetra Tech, 2008).

During the sampling events conducted between 2000 and 2020, only Freon 113, PCP, iron, and manganese exceeded their site characterization PALs and available BTVs. No explosives were detected in groundwater at concentrations greater than their site characterization PALs. Freon 113 is the most extensive contaminant and is observed to be present as three shallow groundwater plumes. The plumes are laterally and vertically delineated. Previous investigations suggest that there may be a continuing saturated soil source, or potentially nonaqueous phase liquid, to the Freon 113 groundwater plumes. On the contrary, PCP exceedances are isolated to one well, JAW-31; concentrations appear relatively stable or decreasing over recent years. PCP has not been detected in soil at Line 9. Both iron and manganese in groundwater at Line 9 are considered to be associated with the 2005–2006 treatability study, which enhanced reducing conditions in groundwater, and are not site-related.

An HHRA and ERA were conducted to quantify potential risks to human health and the environment from exposure to contaminants at the Line 9. The following conclusions were made based on the risk assessments:

- The HHRA identified potential unacceptable risks for future site workers and construction/utility workers and future hypothetical residents exposed to groundwater. Freon 113 and 1,1-DCE were identified as COCs for future site workers; Freon 113 was identified as a COC for future construction/utility workers, and Freon 113, 1,1-DCE, and PCP were identified as COCs for future hypothetical residents.
- The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 9.

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs (Freon 113, 1,1-DCE, and PCP) in groundwater at Line 9. It is recommended that an FS be conducted under OU-6 to evaluate remedial alternatives to address the unacceptable risks in groundwater at Line 9 (IAAP-010G). When developing remedial alternatives, the FS should consider ongoing site operations and the reasonably foreseeable future land use for this area.

SECTION 6

OU-6 Conclusions and Recommendations Summary

An RI was conducted for 10 environmental sites within 8 areas at the IAAAP to refine the nature and extent of contamination in applicable media from historical activities, assess for potential unacceptable risk to human health and the environment, and recommend a path forward.

6.1 RI Conclusions

6.1.1 CC-001G_Line 1 Groundwater (19105.1065)

Potential sources of contamination at Line 1 include historical activities associated with explosives-related processing, assembly, and shipping at various buildings within Line 1, and wastewater treatment at Building 1-70. The major feedstocks historically used at Line 1 included TNT, lead azide, barium nitrate, mercury fulminate, PBX, and antimony sulfate (JAYCOR, 1994a). Metal-cleaning operations, which may have used chromic acid, were also once performed at Line 1 (JAYCOR, 1994a). Primary release points/mechanisms include former wastewater sumps and/or clarifiers at former Buildings 1-05-1, 1-05-2, and 1-08-1 and existing Buildings 1-12 and 1-10; wastewater troughs/discharge points from former Buildings 1-05-1 and 1-05-2; and wastewater discharges and spills and rainwater/groundwater pumping from former subterranean Building 1-40. Active discharges at Line 1 ceased in 1997.

Based on historical site operations and a comparison of the most current concentration data (Table 5.1-5) to site characterization PALs and BTVs, explosives (RDX, TNT, 2,4-DNT, 2,6-DNT, and 2-nitrobenzene) and manganese were identified as potential site-related chemicals of interest in groundwater. Note that chemicals of interest were identified for nature and extent discussion and differ from COPCs identified in the risk assessment. RDX is the most extensive chemical, and the other explosives are present within the RDX plume extents. RDX is present primarily in two larger, greater-concentration plumes and four smaller, lower-concentration plumes. The largest RDX plume is downgradient of former operational Buildings 1-05-1, 1-05-2, 1-70-1, and 1-100. Total manganese was detected at a concentration greater than its PAL and BTV at only one location (JAW-41). This well is located outside and downgradient of the explosives plume footprint. This suggests that manganese is not associated with a site release and may be naturally occurring due to localized geochemical conditions and natural reductive dissolution. The lateral and vertical extents of contamination are delineated at Line 1.

Line 1 consists of buildings, roads, railroad tracks, and drainage ditches, which are surrounded by grass-covered areas. Contaminants have entered groundwater at Line 1 due to the historical discharge of process water from buildings, sumps, and clarifiers and the subsequent leaching of chemicals through the unsaturated zone soil. The groundwater table at Line 1 is shallow, and groundwater in the overburden aquifer was encountered at less than 10 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion at Line 1. Anaerobic daughter products of RDX were detected at Line 1 at the majority of wells with RDX detections, providing evidence that anaerobic biodegradation of RDX has occurred in groundwater at Line 1. However, concentration trends based on a monitoring well within the plume core show RDX concentrations fluctuating, with no overall increasing or decreasing trend, providing inconclusive data for natural attenuation. Nevertheless, the physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in downgradient wells.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals in groundwater at Line 1. The cumulative cancer risk estimate was 9×10^{-4}, and two target organ hazard index (HI) estimates were greater than 1 (hepatic and nervous system). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at Line 1 are TNT (9.5 µg/L), 2-amino-4,6-DNT (16 µg/L), 4-amino-2,6-DNT (11 µg/L), 2,4-DNT (0.57 µg/L), 2,6-DNT (0.086 µg/L), 2-nitrotoluene (3.7 µg/L), and RDX (837 µg/L). The HHRA also identified potential unacceptable risks and hazards in groundwater for future site workers. The cumulative cancer risk estimate was 2×10^{-4}, and two target organ HI estimates were greater than 1 (hepatic and nervous system). The COCs, and corresponding exposure point concentrations, identified for future site workers at Line 1 are TNT (9.5 µg/L), 2-amino-4,6-DNT (16 µg/L), 2-nitrotoluene (3.7 µg/L), 4-amino-2,6-DNT (11 µg/L), and RDX (837 µg/L). No unacceptable risks and hazards were identified for the construction/utility worker; the cumulative risk and target organ HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 1, given the lack of complete exposure pathways for ecological receptors.

6.1.2 IAAP-016_Line 1 Former Wastewater Impoundment (19105.1020)—Soil, Surface Water, and Sediment and IAAP-016G_Line 1 Former Wastewater Impoundment Groundwater (19105.1075)

The source of contamination at the Line 1 Impoundment includes the historical deposition of explosives-contaminated wastewater, coal fragments, and fly ash within the former impoundment. In 1997, active discharge to Brush Creek from Line 1 operations ceased.

Based on historical site operations and a comparison of the most current concentration data (Tables 5.2-3 through 5.2-5) to site characterization PALs and BTVs, metals and explosives were identified as site-related chemicals of interest. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. In groundwater, potential chemicals of interest include explosives (RDX, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) and manganese. Explosives contamination in groundwater is present as a relatively small, shallow plume on the southern end of the former impoundment. Manganese is not associated with historical operations at the Line 1 Impoundment and elevated manganese concentrations in groundwater at Line 1 may be naturally occurring due to localized geochemical conditions. In surface water at the Line 1 Impoundment, potential site-related chemicals of interest include explosives (RDX, hot melt explosive [HMX], TNT, 2-amino-4,6-DNT, and 4-amino-2,6-DNT). In sediment at the Line 1 Impoundment, potential site-related chemicals of interest include explosives (RDX, HMX, TNT, 2-amino-4,6-DNT, and 4-amino-2,6-DNT) and PAHs. Soil and impoundment pond surface water and sediment have been addressed under an interim remedial action, which includes a NTCRA for soil and sediment, rerouting of Brush Creek around the west side of the former impoundment, construction of a water treatment system and hydraulic relief structure, construction of a phytoremediation wetland, treatment system and phytoremediation sampling, and O&M activities.

The Line 1 Impoundment currently consists of a treatment wetland and pond that is surrounded and covered by grass and other vegetation. The ground topography slopes toward Brush Creek and toward the center of the pond. The groundwater table at the site is shallow, and groundwater in the overburden aquifer was encountered at less than 10 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Contaminants have entered sediment and surface water in Brush Creek primarily from other sources than the impoundment, such as historical Line 1 permitted discharge of explosives through outfalls to Brush Creek. The treatment wetland should continue to reduce concentrations of explosives in sediment and surface water within the impoundment pond. Anaerobic daughter products of RDX were detected in groundwater at the Line 1 Impoundment, providing evidence that anaerobic biodegradation of RDX has occurred. However, concentration trends based on a monitoring well within the plume core show RDX concentrations fluctuating, with no overall increasing or decreasing trend, providing inconclusive data for natural attenuation. Nevertheless, the physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in downgradient wells. The lateral and vertical extents of contamination in groundwater at the Line 1 Impoundment are delineated.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals in groundwater at the Line 1 Impoundment. The cumulative cancer risk estimate was 3×10^{-3}, and two target organ HI estimates were greater than 1 (hepatic and nervous system). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at the Line 1 Impoundment are manganese (dissolved) (2,810 µg/L), TNT (1.5 µg/L), 2-amino-4,6-DNT (4.3 µg/L), 4-amino-2,6-DNT (7.4 µg/L), HMX (600 µg/L), and RDX (3,200 µg/L). The HHRA also identified potential unacceptable risks and hazards in groundwater for future site workers. The cumulative cancer risk estimate was 8×10^{-4}, and one target organ HI estimate was greater than 1 (nervous system). The COCs, and corresponding exposure point concentrations, identified for future site workers at Line 1 Impoundment are manganese (dissolved) (2,810 µg/L) and RDX (3,200 µg/L). No unacceptable risks and hazards were identified for the construction/utility worker; the cumulative risk and target organ HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. No chemicals in surface water and sediment from Brush Creek exceeded screening levels; therefore, no COPCs were identified for these media.

Because a portion of Brush Creek runs through the Line 1 Impoundment boundary, surface water and sediment at this site were evaluated under the *Watershed Ecological Risk Assessment for Remedial Investigations at Iowa Army Ammunition Plant, Middletown, Iowa* (CH2M, 2022). No COPECs were identified for Brush Creek (the watershed containing the site) during the watershed ERA (CH2M, 2022). Therefore, the ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at the Line 1 Impoundment Area. Additionally, an interim remedial action is in place that addresses explosives within the impoundment pond, therefore it can be inferred that historical data is overly conservative of current onsite conditions.

6.1.3 IAAP-002G_Line 2 Ammo LAP (Artillery/Shape) Groundwater (19105.1003)

The source of contamination at Line 2 is attributed to wastewater management and LAP activities at the site. During the Preliminary Assessment, wastes found at Line 2 were predominantly explosives. Other potential wastes included solvents and oils, which could have discharged into the sumps before the wastewater treatment plant was operative or before the solvent recovery system was installed.

Based on historical site operations and a comparison of the most current concentration data (Table 5.3-5) to site characterization PALs and BTVs, explosives (RDX, 4-amino-2,6-DNT, 2-amino-4,6-DNT, and nitrobenzene) were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Explosives contamination is present as two plumes, a larger north plume and a smaller south plume. The north RDX plume is present downgradient of melt Building 2-05-2, while the south RDX plume is outside the Line 2 site boundary to the southwest, along Brush Creek. Although the south plume is outside the Line 2 boundary, it has been administratively included with Line 2 because of its proximity. Iron and manganese concentrations were also elevated in groundwater, but these are associated with the 2007–2009 treatability study, which enhanced reducing conditions in groundwater, and are not site-related.

Line 2 is an active LAP facility with buildings, covered walkways, roads, and railroad tracks that are surrounded by grass-covered areas. This site falls within the Brush Creek watershed. Surface water drainage occurs through a number of drainage ditches and culverts, which ultimately discharge to Brush Creek. The groundwater table at Line 2 is shallow, observed at overburden monitoring wells between 6 and 14 feet bgs within the Line 2 site boundary during the current RI. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Vertical migration at the site is limited by the generally tight clay lithology in the overburden. As a result, even lead-contaminated soil, which was removed in 2007, did not impact groundwater. Anaerobic daughter products of RDX were detected at wells located within the north RDX plume, providing evidence that anaerobic biodegradation of RDX has occurred in groundwater at Line 2. Decreasing concentration trends are also observed in the north RDX plume, while concentrations in the south RDX plume have fluctuated. The physical natural attenuation processes are also likely helping to stabilize the plumes, given the very limited extent of the plumes.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals in onsite and offsite groundwater at Line 2. The cumulative cancer risk estimate was $1 \times 10^{-}$,^{3} and four target organ HI estimates were greater than 1 (hepatic, cardiovascular, dermal, and nervous system) for onsite groundwater. The COCs, and corresponding exposure point concentrations, identified for future residential exposures in onsite groundwater at Line 2 are 2-amino-4,6-DNT (7.4 µg/L), 4-amino-2,6-DNT (7.3 µg/L), HMX (160 µg/L), nitrobenzene (14 µg/L), RDX (180 µg/L), and arsenic (44.9 µg/L). For offsite groundwater at Line 2, the future residential receptor cumulative cancer risk estimate was 6×10^{-4}, and one target organ HI estimate was greater than 1 (nervous system). The COC, and corresponding exposure point concentration, identified for future residential exposures in offsite groundwater at Line 2 is RDX (590 µg/L). The HHRA also identified potential unacceptable risks in onsite groundwater for future site workers. The cumulative cancer risk estimate was 3×10^{-4}; the target organ HI estimates were less than 1. The COCs, and corresponding exposure point concentrations, identified for future site workers in onsite groundwater at Line 2 are arsenic (44.9 µg/L) and RDX (180 µg/L). No unacceptable risks and hazards were identified for the site worker exposures for offsite groundwater at Line 2; the cumulative risks were within the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. No unacceptable risks and hazards were identified for the construction/utility worker exposures of either onsite or offsite groundwater at Line 2; the cumulative risks were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1.The ERA concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective at Line 2, given the lack of complete exposure pathways for ecological receptors.

6.1.4 IAAP-003G_Line 3 Ammo LAP (Artillery) Groundwater (19105.1005)

The source of contamination at Line 3 is attributed to historical explosives LAP operations and metal treatment operations at site buildings and sumps. The areas with the greatest volume of explosives wastewater occurred at the two melt buildings located in the center of the site. Other potential release sources include explosives-contaminated wastewater from sump overflows, solvent and paint remover wastes from paint-stripping and renovation activities, contaminated wastewater from production room washdowns onto the ground or into nearby drainageways, spills at material receiving docks, and dust releases from open windows and doors. The wastewater generated from metal-cleaning processes was discharged to the wastewater treatment plant at Line 3.

Based on historical site operations and a comparison of the most current concentration data (Table 5.4-3) to site characterization PALs and BTVs, explosives (2,4-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX) were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Since 2000, explosives exceedances have been observed in only one shallow overburden monitoring well, JAW-54, located near the soil removal areas and former sumps associated with melt

Building 3-05-01. Groundwater samples collected downgradient of Building 3-10 did not have explosives concentrations exceeding site characterization PALs.

Line 3 is primarily grass covered, with a few buildings and a few roads that lead to the demolished building footprints remaining. Surface runoff moves toward intermittent tributary that joins Brush Creek. Contaminants have entered groundwater at Line 3 due to the historical discharge of process water from buildings and sumps and the subsequent leaching of chemicals through unsaturated zone soil. The groundwater table at Line 3 is shallow, and groundwater in the overburden aquifer was encountered between 1 and 8 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Given that the overburden aquifer is composed predominantly of clays and the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow except for in the sand seams present in the aquifer. Explosives concentrations have decreased in the one well with exceedances, JAW-54, indicating that natural attenuation is occurring. Anaerobic daughter products of RDX were also detected in this well.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals groundwater at Line 3. The cumulative cancer risk estimate was 3×10^{-4} and two target organ HI estimates were greater than 1 (hepatic and nervous system). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at Line 3 are 2,4-DNT (0.91 µg/L), 2,6-DNT (0.16 µg/L), 2-amino-4,6-DNT (47 µg/L), 4-amino-2,6-DNT (18 µg/L), and RDX (289 µg/L). The HHRA also identified potential unacceptable hazards in groundwater for future site workers. One target organ HI estimate was greater than 1 (hepatic). The cumulative cancer risk estimate for the future site worker were within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}. The COCs, and corresponding exposure point concentrations, identified for future site workers at Line 3 are 2-amino-4,6-DNT (47 µg/L) and 4-amino-2,6-DNT (18 µg/L). No unacceptable risks and hazards were identified for the construction/utility worker; the cumulative risk and target organ HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 3, given the lack of complete exposure pathways for ecological receptors.

6.1.5 IAAP-004G_Line 3A Ammo LAP (Artillery) Groundwater (19105.1007)

The primary source of contamination at Line 3A is attributed to the LAP operations, including the use of TNT, RDX, MHX, ammonium nitrate; various solvents from paint-stripping and renovation operations; and metals; and from explosives-contaminated wastewater from sump overflows or spills. The sumps at Line 3A are no longer in use for processing wastewater. The site remains an active LAP line.

Based on historical site operations and a comparison of the most current concentration data (Table 5.5-5) to site characterization PALs and BTVs, one explosive (RDX) was identified as a site-related chemical of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. RDX is present as one large plume at Line 3A and exceedances were observed at six shallow overburden wells and two deep overburden locations. The maximum concentration was detected downgradient of Building 3A-05-2. The RDX plume is laterally and vertically delineated.

Line 3A is a relatively flat, active line that sits on top of a ridge dividing the Long Creek watershed to the north and the Skunk River watershed to the south. The fine-grained (clay) geology at the site should facilitate sorption of chemicals of interest and retard vertical migration by limiting leaching. RDX concentrations have increased in groundwater at several well locations between 2008 and 2018. Therefore, there may be a continuing source to groundwater at this site. This includes the two excavation areas where soil could not be removed to OU-1 remedial goals.

The HHRA did not identify any unacceptable risks or hazards for future residential receptors exposed to site-related chemicals in groundwater at Line 3A. The cumulative cancer risk estimate for hypothetical residents was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4} and all target organ HIs were less than 1. Future site worker and construction/utility worker risks and hazards were not quantified in the HHRA because the hypothetical residential scenario did not exceed acceptable risk levels and COCs were not identified for a residential scenario; the residential scenario is considered protective of receptors with fewer exposures. The ERA concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective at Line 3A, given the lack of complete exposure pathways for ecological receptors.

6.1.6 IAAP-006G_Line 5A and 5B Ammo Assembly Groundwater (19105.1067)

The sources of contamination at Lines 5A/5B are attributed to the historical explosives-related operations at the site buildings and to process wastewater. The principal explosives used at both lines were TNT and tetryl. Historical releases at Line 5B may have occurred at Buildings 5B-140-1, 5B-140-2, 5B-140-3, 5B-28, and 5B-29. Additionally, process wastewater generated at Lines 5A and 5B was formally discharged through NPDES Outfalls 51 and 52. Operations at the site ended by 2005.

Based on historical site operations and a comparison of the most current concentration data (Tables 5.6-7 and 5.6-8) to site characterization PALs and BTVs, explosives (RDX, 4-Amino-2,6-DNT, and 2-Amino-4,6-DNT) were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Two small explosives plumes are present, one at Line 5A and one at Line 5B. At Line 5A, exceedances were observed only at shallow overburden well 5A-MW2. At Line 5B, exceedances were also observed at only one shallow overburden well, 5B-MW1, which is adjacent to the soil removal areas and former sumps associated with former Buildings 5B-28 and 5B140-3. The lateral and vertical extents of contamination are delineated and the plumes are limited in extent.

Lines 5A/5B are primarily grass covered with a few remaining roads leading to the demolished building footprints. Surface runoff in the eastern half of the site (Line 5A) moves toward an intermittent tributary of Brush Creek, whereas surface runoff in the western half of the site (Line 5B) moves to the southwest toward a tributary to Long Creek. Contaminants have entered groundwater at Lines 5A and 5B due to the historical discharge of process water from buildings and sumps and the subsequent leaching of chemicals through unsaturated zone soil. The groundwater table at Lines 5A/5B is shallow, and groundwater in the overburden aquifer was encountered between 4 and 9 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Given that the overburden aquifer is composed predominantly of clays and the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow, except for in the sand seams present in the aquifer. Anaerobic daughter products of RDX were detected at wells located both Lines 5A and 5B; however, more degradation products were observed in Line 5A groundwater. The trend graphs indicate that RDX concentrations have remained relatively stable at 5A-MW2 since 2006 while RDX concentrations have decreased at 5B-MW1 after 2007. This decrease in concentrations indicates that natural attenuation is occurring. The physical natural attenuation processes are also likely helping to stabilize the plumes, given the very limited extent of the plumes.

Risks were assessed separately for Lines 5A and 5B due to the large size of each line (Line 5A is 33 acres and Line B is 41 acres), the separation distance between the two lines, and the presence of individual plumes at each line. The HHRA identified potential unacceptable hazards for future residential receptors exposed to site-related chemicals in groundwater at Line 5A. One target organ HI estimate was greater than 1 (hepatic). The cumulative cancer risk estimate for hypothetical residents was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}. The COCs, and corresponding exposure point concentrations, identified for future residential exposures at Line 5A are 2-amino-4,6-DNT (6.9 µg/L) and 4-amino-2,6-DNT (43 µg/L). The HHRA also identified potential unacceptable hazards for future site workers exposed to site-related chemicals in groundwater at Line 5A. One target organ HI estimate was greater than 1 (hepatic). The cumulative cancer risk estimate for site workers was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}. The COCs, and corresponding exposure point concentrations, identified for future site worker exposures at Line 5A are 2-amino-4,6-DNT (6.9 µg/L) and 4-amino-2,6-DNT (43 µg/L). The cumulative cancer risk estimates for construction/utility workers at Line 5A were within USEPA's target risk range of 1×10^{-6} to 1×10^{-4} and all target organ HIs were less than 1. For Line 5B, the cumulative cancer risk estimate for hypothetical residents was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4} and all target organ HIs were less than 1. Future site worker and construction/utility worker risks and hazards at Line 5B were not quantified in the HHRA because the hypothetical residential scenario did not exceed acceptable risk levels and COCs were not identified for a residential scenario; the residential scenario is considered protective of receptors with fewer exposures. The ERA concluded that there are no adverse effects to ecological receptors identified, and no additional actions are required from an ecological perspective at Line 5A or Line 5B, given the lack of complete exposure pathways for ecological receptors at these sites.

6.1.7 IAAP-044_Line 800 and Pinkwater Lagoon (19105.1048)—Soil, Surface Water, and Sediment and IAAP-044G Line 800 and Pinkwater Lagoon Groundwater (19105.1049)

Potential sources of contamination at Line 800 include historical releases of explosive compounds associated with ammunition production. The primary explosive compounds historically used at Line 800 included TNT, RDX, Composition B, black powder, HMX, and pentaerythritol. Primary release points/mechanisms include former wastewater sumps, melt buildings, and screening buildings. Active discharges at Line 800 ceased in 1997. Potential sources of contamination at the Line 800 Pinkwater Lagoon include explosives-contaminated effluent and metals-contaminated sludge disposed in the lagoon while it was in use as a settling pond to reduce particulates before discharge to surface drainage to Brush Creek, and subsequent historical leaching through soil and sediment at the bottom of the pond.

Based on historical site operations and a comparison of the most current concentration data (Table 5.7-6) to site characterization PALs and BTVs, explosives (1,3,5-TNB, 1,3-DNB, TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, HMX, nitrobenzene, and RDX), Freon 113, and 1,2-DCA were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Explosives contamination in groundwater is present as a large, shallow plume that extends from the southeastern portion of Line 800 and runs beneath the Pinkwater Lagoon. RDX is the most extensive chemical, and the other explosives are present within the RDX plume extents. The greatest RDX concentration was reported at the southwest edge of the lagoon. The lateral and vertical extents of the explosives plume have been defined. Soil, surface water, and sediment in the pond at the Pinkwater Lagoon have been addressed via the interim remedial action, which includes a NTCRA for soil/sediment, construction of a berm across the lagoon to separate the large and small pools of the lagoon, installation of outlet works to control discharges to the Brush Creek tributary, installation of a temporary granular activated carbon treatment system, construction of a 9-acre phytoremediation wetland and treatment system, phytoremediation sampling, and other O&M activities.

Line 800 consists of buildings, roads, railroad tracks, and drainage ditches, which are surrounded by grass-covered areas. The Line 800 Pinkwater Lagoon currently consists of a treatment wetland and two lagoon ponds that are surrounded by a grassy berm and other vegetation. Due to a topographic divide at the site, at which the ground surface slopes gently to the southeast and to the southwest, Line 800 and Pinkwater Lagoon fall within both the Long Creek watershed and the Brush Creek watershed. Surface water in the pond is subject to controlled discharge to the Brush Creek tributary north of the lagoon. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Although a downward vertical gradient is evident at well pairs throughout the site, the lack of elevated contaminant concentrations in bedrock groundwater samples indicates vertical migration at the site is limited by the generally tight clay lithology in the overburden. Anaerobic daughter products of RDX were detected at most wells with RDX detections, providing evidence that anaerobic biodegradation of RDX has occurred in groundwater at Line 800 and Pinkwater Lagoon. Overall, concentration trend data also provide supporting evidence for natural attenuation or enhanced biodegradation of explosives due to the treatability study at Line 800 and Pinkwater Lagoon. Physical natural attenuation processes are also likely helping to stabilize the plumes, given the lack of, or low levels of, explosives in cross-gradient and downgradient wells.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals groundwater at Line 800 and Pinkwater Lagoon. The cumulative cancer risk estimate was 1×10^{-3} and five target organ HI estimates were greater than 1 (NOE, gastrointestinal, hepatic, immune, and nervous system). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at the Line 800 and Pinkwater Lagoon are iron (120,025 µg/L—tap water), manganese (12,792 µg/L—tap water), 1,3-dinitrobenzene (7.6 µg/L—tap water), TNT (174 µg/L—tap water), 2,4-DNT (12 µg/L—tap water), 2,6-DNT (4.0 µg/L—tap water), 2-amino-4,6-DNT (25 µg/L—tap water), 2-nitrotoluene (0.51 µg/L—tap water), 3-nitrotoluene (7.8 µg/L—tap water), 4-amino-2,6-DNT (28 µg/L—tap water), nitrobenzene (3.4 µg/L—tap water), RDX (974 µg/L—tap water), Freon 113 (39,800 µg/m^3—indoor air; 2,900 µg/L—tap water), and 1,2-DCA (6.2 µg/L—tap water). The HHRA also identified potential unacceptable risks and hazards for future site workers. The cumulative cancer risk estimate was 3×10^{-4} and three target organ HI estimates were greater than 1 (NOE, hepatic, and nervous system). The COCs, and corresponding exposure point concentrations, identified for future site worker exposures at the Line 800 and Pinkwater Lagoon are manganese (12,792 µg/L—tap water), TNT (174 µg/L—tap water), 2-amino-4,6-DNT (25 µg/L—tap water), 4-amino-2,6-DNT (28 µg/L—tap water), RDX (974 µg/L—tap water), and Freon 113 (39,800 µg/m^3—indoor air; 2,900 µg/L—tap water) in groundwater. No unacceptable risks and hazards were identified for the construction/utility worker; the cumulative risk and target organ HIs were less than the USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} and acceptable HI of 1. The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 800 and Pinkwater Lagoon, given that an interim remedial action is in place that addresses explosives within the lagoon impoundment and RDX concentrations in surface water collected from Pinkwater Lagoon are much less than the surface water ESVs.

6.1.8 IAAP-010G_Line 9 Ammo LAP (Mine) Groundwater (19105.1014) Line 9 Groundwater (IAAP-010G)

The sources of contamination at Line 9 are attributed to the historical processing of explosives, use of volatile organic compounds during site operations, and process wastewater. Explosives and chemicals handled at Line 9 included RDX, TNT, PBX, HMX, pentaerythritol tetranitrate, lead azide, boron potassium nitrate, black powder, sodium thiosulphate, thiosulphate, antimony sulfides, Freon, polychlorinated biphenyls, and various other solvents, paints, and lacquers. Although no spills were recorded at Line 9, historical releases may have occurred at two of the former sumps, which are considered the main source of the Freon 113 plume. Explosives-contaminated water from Line 9 was transported to Line 3A for treatment in carbon columns. Operations at the site ended sometime after 1991.

Based on historical site operations and a comparison of the most current concentration data (Table 5.8-4) to site characterization PALs and BTVs, one VOC (Freon 113) and one SVOC (PCP) were identified as site-related chemicals of interest in groundwater. Note that chemicals of interest were used for nature and extent discussion and differ from COPCs identified in the risk assessment. Freon 113 is the most extensive contaminant and is observed to be present as three shallow groundwater plumes. The plumes are laterally and vertically delineated. On the contrary, PCP exceedances are isolated to one well, JAW-31, and were not observed during the most recent sampling. Iron and manganese concentrations were also elevated in groundwater, but this is associated with the 2005–2006 treatability study, which enhanced reducing conditions in groundwater, and are not site-related.

Line 9 is primarily grass covered with a few remaining roads that lead to the cleared/paved areas associated with demolished building footprints. Surface drainage is via culverts and several constructed drainage ditches, which are typically shallow on the northern half of the site and increase in depth on the southern half of the site and remain dry most of the year. The groundwater table at Line 9 is shallow, and groundwater in the overburden aquifer was encountered between 4 and 12 feet bgs. Contaminants in groundwater have been transported from the source release areas through advection and dispersion. Given that the overburden aquifer is predominantly composed of clays and the hydraulic gradient is assumed to be low, the groundwater flow velocity should be slow, except for in the sand seams present in the aquifer. Freon 113 concentrations in groundwater at Line 9 suggest increasing trends, whereas recent PCP concentrations appear relatively stable or decreasing. Previous investigations suggest that Freon 113 has been potentially present as nonaqueous phase liquid in the saturated zone in borings located at the northeast corner of the conveyor at Building 9-57 and east of the building. This information suggests there may be a continuing source to groundwater. Nevertheless, natural attenuation processes are likely helping to stabilize the plumes, given the very limited extent of the plumes.

The HHRA identified potential unacceptable risks and hazards for future residential receptors exposed to site-related chemicals groundwater at Line 9. The cumulative cancer risk estimate was 8×10^{-4} and two target organ HI estimates were greater than 1 (NOE and hepatic). The COCs, and corresponding exposure point concentrations, identified for future residential exposures at Line 9 are Freon 113 (6,310,000 µg/m^3—indoor air; 462,456 µg/L—tap water), 1,1-DCE (380 µg/m^3—indoor air; 535 µg/L—tap water), and PCP (6 µg/L—tap water). The HHRA also identified potential unacceptable hazards in groundwater for future site workers and construction/utility workers. The cumulative cancer risk estimate for site workers was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}; one target organ HI (NOE) estimate was greater than 1. The COC, and corresponding exposure point concentration, identified for future site workers at Line 9 is associated with exposure to Freon 113 (6,310,000 µg/m^3—indoor air; 462,456 µg/L—tap water). The cumulative cancer risk estimate for construction/utility workers was within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}; one target organ HI (NOE) estimate was greater than 1. The COC, and corresponding exposure point concentration, identified for future construction/utility workers at Line 9 is associated with exposure to Freon 113 (6,310,000 µg/m^3—trench air). The ERA concluded that there are no adverse effects to ecological receptors identified and no additional actions are required from an ecological perspective at Line 9, given the lack of complete exposure pathways for ecological receptors.

6.2 Recommendations

Based on the results of the RI and risk assessments, additional action is warranted to mitigate potential unacceptable risks to future receptors from site-related COCs at all eight areas. It is recommended that FSs be conducted as described below:

- It is recommended that five IAAAP sites (CC-IAAP-001G, IAAP-002G, IAAP-003G, IAAP-006G, and IAAP-010G) remain under OU-6. An FS should be completed for these sites to evaluate remedial alternatives to address the unacceptable risks or hazards from site-related COCs in groundwater.
- It is recommended that one IAAAP site (IAA-004G) be transferred to OU-11, as NFA is warranted for groundwater at this site. NFA will be presented at the preferred remedy in an OU-11 Proposed Plan. This recommendation is based on the fact that site-related chemicals do not pose potential unacceptable risks, hazards, or adverse effects.

- It is recommended that four IAAAP sites (IAAP-016, IAAP-016G, IAAP-044, and IAAP-044G) be transferred to OU-7. An FS should be completed for these sites to evaluate remedial alternatives to address the unacceptable risks or hazards from site-related COCs in multiple media. An interim remedial action is currently in place for both the former Line 1 Impoundment and Pinkwater Lagoon. This interim action is supported by ongoing O&M activities and is effectively addressing soil, sediment, and surface water media at these sites (IAAP-016/IAAP-016G and IAAP-044/IAAP-044G). However, the interim action does not currently fall under an OU. It is recommended that the interim action be presented as the final remedy for these sites and memorialized in a decision document. Because this action will address multiple media and require ongoing O&M, it is recommended that these sites be placed under OU-7. Although the interim actions do not specifically address groundwater at either the former Line 1 Impoundment or Pinkwater Lagoon, it is suggested that groundwater media (IAAP-016G and IAAP-044G) also be included under OU-7 so that a more comprehensive remedial approach can be developed for these areas.

The recommendations for the 10 IAAAP sites (located within 8 areas) are summarized in Table 6-1:

Table 6-1. RI Recommendations for 10 Sites
Iowa Army Ammunition Plant, Middletown, Iowa

RI Recommendation	HQAES ID	HQAES ID Name (and AEDB Site Number[a])
FS for groundwater under OU-6	19105.1065	CC-001G_Line 1 Groundwater
	19105.1003	IAAP-002G_Line 2 Ammo LAP (Artillery/Shape) Groundwater
	19105.1005	IAAP-003G_Line 3 Ammo LAP (Artillery) Groundwater
	19105.1067	IAAP-006G_Line 5A and 5B Ammo Assembly Groundwater
	19105.1014	IAAP-010G_Line 9 Ammo LAP (Mine) Groundwater
FS for multiple media under OU-7	19105.1021	IAAP-016_Line 1 Former Wastewater Impoundment
	19105.1075	IAAP-016G _Line 1 Former Wastewater Impoundment Groundwater
	19105.1048	IAAP-044_Line 800 and Pinkwater Lagoon
	19105.1049	IAAP-044G_Line 800 and Pinkwater Lagoon Groundwater
NFA for groundwater under OU-11	19105.1007	IAAP-004G_Line 3A Ammo LAP (Artillery) Groundwater

[a] The AEDB number for each site is the first portion of the HQAES ID name. For example, the AEDB number for Line 2 Ammo LAP (Artillery/Shape) Groundwater is “IAAP-002G.”

References

ACCLPP (Advisory Committee on Childhood Lead Poisoning Prevention). 2012. *Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention*. Atlanta, GA. Centers for Disease Control and Prevention. http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_030712.pdf.

Aerostar (Aerostar SES LLC). 2016. *Line 1 Impoundment and Line 800 Lagoon Operations and Maintenance Plan*. March.

ATSDR (Agency for Toxic Substances and Disease Registry). 2013. *Draft Toxicological Profile For Dinitrotoluenes*. April.

ATSDR (Agency for Toxic Substances and Disease Registry). 2022. Minimal Risk Levels. https://www.atsdr.cdc.gov/mrls/index.asp.

Battelle. 1984. *Follow-On Study of Environmental Contamination Final at the Iowa Army Ammunition Plant*. Project Management Division. Prepared for Iowa Army Ammunition Plant and U.S. Army Toxic and Hazardous Materials Agency. August.

Battelle. 2015. *Attenuation Pathways for Munitions Constituents in Soils and Groundwater*. Technical Report TR-NAVFAC EXWC-EV-1503. Prepared for NAVFAC EXWC. January.

Best, E.P.H., J.L. Miller, M.E. Zappi, H.L. Fredrickson, S.L. Sprecher, S.L. Larson, and T. Strekfuss. 1998. "Explosives Removal from Groundwater of the Iowa Army Ammunition Plant in Flow-through Systems Planted with Aquatic and Wetland Plants." Technical Report EL-98-13. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Bhate. 2011. *Completion Report, Demolition of Multiple Buildings, Iowa Army Ammunition Plant*. April.

Brack Jr., V., and J.O. Whitaker Jr. 2001. "Foods of the Northern Myotis, Myotis Septentrionalis, from Missouri and Indiana, with Notes on Foraging." *Acta Chiropterologica*. Vol. 3. pp. 203–210.

Busard, Jennifer, IAAAP Project Manager. 2019. Personal communication (email) with Renee Caird, Jacobs.

Caceres, M.C., and M.J. Pybus. 1997. *Status of the Northern Long-Eared Bat (*Myotis septentrionalis*) in Alberta*. Wildlife Status Report No. 3. Alberta Environmental Protection, Wildlife Management Division, Edmonton, AB. 19 pp.

Cal EPA (California Environmental Protection Agency). 2022. Toxicity Criteria Database. https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary. Accessed April 2022.

CB&I (CB&I Federal Services). 2014. *Record of Decision Operable Unit 5, Military Munitions Response Program, Iowa Army Ammunition Plant, Middletown, Iowa*. Prepared on behalf of USACE. September.

CCJM (C.C. Johnson & Malhotra, P.C.). 2004. *Iowa Army Ammunition Plant Sampling and Reconnaissance of Brush Creek.* January 20.

CDC (Centers for Disease Control and Prevention). 2007. *Interpreting and Managing Blood Lead Levels <10 12 µg/dL in Children and Reducing Childhood Exposures to Lead. Recommendations of CDC's 13 Advisory Committee on Childhood Lead Poisoning Prevention*. Morbidity Mortality Weekly Report, 14 2007. 56.

CDM (CDM Federal Programs Corporation). 1994. *Engineering Evaluation/Cost Analysis for the Pink Water Lagoon and the Line I Impoundment at Iowa Army Ammunition Plant*. December.

CDM (CDM Federal Programs Corporation). 1996. *Action Memorandum for the Line 800 Pinkwater Lagoon, Former Line 1 Impoundment*. October.

CH2M. 2017a. *Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa.* December.

CH2M. 2017b. Final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa* (Packet 1). December.

CH2M. 2018a. Final *Site-specific Worksheets for Operable Unit 6 of the Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa (Packet 2).* April.

CH2M. 2018b. *Basewide Environmental and Waste Management Plan. Iowa Army Ammunition Plant, Middletown, Iowa*.

CH2M. 2019a. *Interim Deliverable for the Human Health Risk Assessment–RAGS Part D Tables–Line 2 LAP, Iowa Army Ammunition Plant, Middletown, Iowa*. August.

CH2M. 2019b. *Iron Bioreactor Treatability Study, Predesign Investigation, Line 1, Iowa Army Ammunition Plant, Middletown, Iowa*. April.

CH2M. 2020a. *Evaluation of Background Concentrations of Metals in Groundwater, Iowa Army Ammunition Plant, Middletown, Iowa.* February.

CH2M. 2020b. *Evaluation of Background Concentrations of Metals in Sediment and Surface Water, Iowa Army Ammunition Plant, Middletown, Iowa.*

CH2M. 2020c. Draft *Line 6 Ammo Production (Detonator) Interim Deliverable, Human Health Risk Assessment, RAGS Part D Tables, Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa*. September.

CH2M. 2021. Draft *Remedial Investigation Report for Installation Restoration Program Operable Unit 11, Iowa Army Ammunition Plant, Middletown, Iowa*. February.

CH2M. 2022. Draft *Watershed Ecological Risk Assessment for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa.* June.

Coble, R.W. 1971. *The Water Resources of Southeast Iowa*. Iowa Geological Survey Water Atlas No. 4. 100 pp.

Dames & Moore. 1986. *Midwest Site Confirmation Survey Sampling Report for Iowa Army Ammunition Plant*. August.

Dames & Moore. 1989a. Draft Final *Report Endangerment Assessment, Iowa Army Ammunition Plant: Former Line 1 Impoundment and Line 800 Pink Water Lagoon*. July.

Dames & Moore. 1989b. Draft Final *Feasibility Study, Line 1 Impoundment and Line 800 Pink Water Lagoon*. August.

Department of the Army. 1993. *Action Memorandum: Iowa Army Ammunition Plant Permanent Potable Water Supply*.

Department of the Army and USEPA. 1998. *U.S. Army Interim Soils Action for Operable Unit #1 Record of Decision*. August.

ECC. 2001a. Final *Remedial Action Report, Multiple Removal Actions, Iowa Army Ammunition Plant, Middletown, Iowa*. April.

ECC. 2001b. Final *Remedial Action Report, Iowa Ammunition Plant, Focused Feasibility Study Sites, Remedial Action—Phase II, Middletown, Iowa, US Army Corps of Engineers*. April.

ERG (Environmental Research Group). 1982. *Contamination Survey, Iowa Army Ammunition Plant.* September.

ERG (Environmental Research Group). 2005. *Issue Paper on the Environmental Chemistry of Metals*. January.

Federal Geographic Data Committee. 2002. *Geospatial Positioning Accuracy Standards, Part 4: Standards for Architecture, Engineering, Constructions (A/E/C) and Facility Management*. FGDC-STD-007.4-2002. 23 pp. https://www.fgdc.gov/standards/projects/accuracy/part4/FGDC-endorsed-standard

H&S Environmental. 2016. Final *Preliminary Assessment Report, Mathes Lake, Iowa Army Ammunition, Plant, Middletown, Des Moines, Iowa*. January.

Harza. 1998. Final *Record of Decision (Revision 1), Soils, Operable Unit #1, Iowa Army Ammunition Plant, Middletown, Iowa*. August.

Harza. 2001. Draft Final *Technical Memorandum, Evaluation of Contaminant Sources to Surface Streams, Iowa Army Ammunition Plant, Middletown, Iowa*. July.

IAAAP. 2023. *Demo Master List Email Correspondence with Randy Doyle*, Chief, Operations Support Division. April.

IDNR (Iowa Department of Natural Resources). 2003. *Iowa's Groundwater Basics*. State of Iowa, Iowa City. p. 83.

Jacobs. 2022. *Reevaluation of Background Concentrations of Soil in Groundwater, Iowa Army Ammunition Plant, Middletown, Iowa*. April.

JAYCOR. 1992. Final *Work Plan Iowa Army Ammunition Plant Phase I Remedial Investigation/Feasibility Study.* Prepared for U.S. Army Toxic and Hazardous Materials Agency. June.

JAYCOR. 1993a. *Preliminary Site Characterization Reports*. March.

JAYCOR. 1993b. *Final Contamination Assessment of Concrete Sumps at Iowa Army Ammunition Plant.* June.

JAYCOR. 1994a. *Preliminary Assessments for the 43 Iowa Army Ammunition Plant Sites*. October.

JAYCOR. 1994b. Draft Final *Report (Revised) Baseline Human Health and Ecological Risk Assessment, Former Line I Impoundment and Pink Water Lagoon.*

JAYCOR. 1996. *Revised Draft Final Remedial Investigation Report, Iowa Army Ammunition Plant*. May.

JAYCOR and ICAIR (JAYCOR Environmental and ICAIR Life Systems). 1994. Draft Final *Report (Revised) Baseline Human Health and Ecological Risk Assessment, Iowa Army Ammunition Plant, Middletown, Iowa, Former Line I Impoundment and Pink Water Lagoon*. Prepared for U.S. Army Environmental Center. June.

Jong, C.G. Van Zyll De. 1985. *Handbook of Canadian Mammals: Bats*. Univ. of Chicago Press. 212 pp.

LaVal, R.K., R.L. Clawson, M.L. LaVal, and W. Caire 1977. "Foraging Behavior and Nocturnal Activity Patterns of Missouri Bats, with Emphasis on the Endangered Species *Myotis grisescens* and *Myotis sodalis*." *Journal of Mammalogy.* Vol. 58, no. 4. pp. 592–599.

Leidos. 2018. *Explanation of Significant Differences for the Records of Decision Soils Operable Unit 1 (OU-1) Addition of Land Use Controls, Off-site Disposal of Contaminated Soil, and the Fire Training Pit for Iowa Army Ammunition Plant, Middletown, Iowa*

Leidos. 2019. Final *Operable Unit 1 Land Use Controls Implementation Plan, Iowa Army Ammunition Plant, Middletown, Iowa.* November.

Leidos. 2020. Draft *Interim Deliverable for the Human Health Risk Assessment – RAGS Part D Tables – Building 600-86 Septic System, Operable Unit 7, Iowa Army Ammunition Plant, Middletown, Iowa*. August.

Mahaffey, W.R. 1997. *Bioremediation of Pentachlorophenol, Literature Survey of Metabolic Pathways and Rate Constants.* Pelorus Environmental & Biotechnology Corporation, Evergreen, CO.

Mason & Hanger–Silas Mason. 1973. *1973 Annual Supplement to Unit History, Iowa Army Ammunition Plant*. 1 July 1972 through 30 June 1973.

Mason & Hanger–Silas Mason. 1990. *Replace/Upgrade Explosives Collection Sumps Study*. December.

McFarlan, S. 1998. 2,4,6-Trinitrotoluene Pathway Map. Swiss Federal Institute of Aquatic Science and Technology (EAWAG). http://eawag-bbd.ethz.ch/tnt/tnt_map.html.

McKown, Gary L., Jill M. Meuser, Christine M. Smith, and James M. Doesburg. 1984. *Follow-on Study of Environmental Contamination at the Iowa Army Ammunition Plant*. August.

MWH (Montgomery Watson Harza). 2001. Revised draft final *Supplemental Groundwater Remedial Investigation Report. Iowa Army Ammunition Plant (IAAAP), Middletown, Iowa*. August 31.

MWH (Montgomery Watson Harza). 2004. Draft final *Baseline Ecological Risk Assessment, Iowa Army Ammunition Plant (IAAAP), Iowa*. October.

National Library of Medicine. 2015. Hazardous Substances Data Bank. Available from: http://toxnet .nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

National Weather Service. 2020. Weather.gov.

OHM. 1996. Draft final *Report: Rapid Response IAAAP Removal Actions (Pesticide Pit and Explosive-Contaminated Sumps).* January.

PARS-Gannett Fleming. 2019. *Fiscal Year 2018 Annual Land Use Control and Operation and Maintenance Report, Iowa Army Ammunition Plant, Middletown, Des Moines County, Iowa*. Draft. Prepared for US Army Corps of Engineers, Louisville District. February.

PARS-Gannett Fleming. 2020. Final *Work Plan Restore Capacity of Line 1 Impoundment Iowa Army Ammunition Plant, Middletown, Iowa*. November.

PARS-Gannett Fleming. 2021. *Fiscal Year 2020 Annual Land Use Control and Operation and Maintenance Report, Iowa Army Ammunition Plant, Middletown, Des Moines County, Iowa*. Draft. Prepared for US Army Corps of Engineers, Louisville District. January.

PARS-Gannett Fleming. 2022. *Fiscal Year 2021 Annual Land Use Control and Operation and Maintenance Report, Iowa Army Ammunition Plant, Middletown, Des Moines County, Iowa*. Draft. Prepared for US Army Corps of Engineers, Louisville District. August.

Pennington, J.C., R. Bowen, J.M. Brannon, M. Zakikhani, D.W. Harrelson, D. Gunnison, J. Mahannah, J. Clarke, T.F. Jenkins, and S. Gnewuch. 1999. Draft *Protocol for Evaluating, Selecting, and Implementing Monitored Natural Attenuation at Explosives-contaminated Sites*. Technical Report EL-99-10. Prepared for U.S. Army Corps of Engineers. September.

Phytoworks. 1999. *Line 1 & Line 800 Phytoremediation Monitoring*. February.

Pond & Company. 2017. *Final Vision Plan, Iowa Army Ammunition Plant*. June.

Stantec. 2018. *Iowa Army Ammunition Plant Integrated Natural Resources Management Plan and Categorical Exclusion*. May.

SCS (Stearns, Conrad, & Schmidt Consulting Engineers). 1982. *Underground Pollution Investigation, Iowa Army Ammunition Plant.* February 22.

Shaw. 2004a. Internal Draft *Remedial Action Report for Phase 4 Soil Sites, OU-1, Iowa Army Ammunition Plant*. December 8.

Shaw. 2004b. Draft final *Remedial Action Work Plan for Soil Excavation, Phase 4 Soil Sites, Operable Unit 1, Iowa Army Ammunition Plant, Middletown, Iowa*. Revision 1. Prepared for U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska. May 20.

Shaw. 2005a. Draft Final *Historical Records Review of Line 2, Line 3, Line 3A, Incendiary Disposal Area, Old Fly Ash Waste Pile, Possible Demolition Site, Explosives Waste Incinerator, Construction Debris Landfill, and Line 3A Pond*. January.

Shaw. 2005b. Draft *Remedial Action Report Phase 4 Soil Sites Operable Unit 1, Iowa Army Ammunition Plant Middletown, Iowa, Revision 1, Prepared for U.S. Army Corps of Engineers, Omaha District, Omaha.* August.

TAC Environmental, LLC. (TAC). 2022. Final *Uniform for Federal Policy for Quality Assurance Project Plan Contaminated Soil Remedial Design, Iowa Army Ammunition Plant, Middletown, Iowa*. Prepared for U.S. Army Corps of Engineers, Louisville District. March.

Tetra Tech. 2006a. *Draft Final Supplemental Remedial Investigation Work Plan and Regulatory Path Forward for Six Non-ERA Eligible Sites, Iowa Army Ammunition Plant, Middletown, Iowa.* March*.*

Tetra Tech. 2006b. Final *Comprehensive (Brush Creek, Spring Creek, Long Creek, and Skunk River) Watersheds Evaluation and Supplemental Data Collection Work Plan (CWWP)*. December.

Tetra Tech. 2008. Draft *Phase I Treatability Study Report for In-situ Biodegradation of On-Post Groundwater for Iowa Army Ammunition Plant, Middletown, Iowa.* April.

Tetra Tech. 2009a. Final *Remedial Action Completion Report for Operable Unit 1 (OU-1) Soils, Phase 5, 7, and 8 Sites and Installation Wide Ecological, Iowa Army Ammunition Plant, Middletown, Iowa*. August.

Tetra Tech. 2009b. *Supplemental Remedial Investigation Report for Five Compliance-Related Cleanup Sites for Iowa Army Ammunition Plant, Middletown, Iowa*. July.

Tetra Tech 2010. *Draft Progress Report Phase 1 Full-Scale Treatability Study for In Situ Biodegradation of On-site Groundwater, Iowa Army Ammunition Plant, Middletown, Iowa.* April.

Tetra Tech. 2011a. Final–*Rev. 3 Supplemental Remedial Investigation, Operable Unit (OU) 7, Iowa Army Ammunition Plant*. August.

Tetra Tech. 2011b. Final *Work Plan for Supplemental Remedial Investigation of Groundwater and Surface Water at Line 1 for IAAAP.*

Tetra Tech. 2012a. Draft *Supplemental Remedial Investigation for Onsite Groundwater Operable Unit 6 (OU-6), Iowa Army Ammunition Plant, Middletown, IA*. July.

Tetra Tech. 2012b. Draft Final *Technical Memorandum and Work Plan Addendum, Line 1 Groundwater and Surface Water, Phase 1 Sampling Results and Phase 2 Work Plan Addendum for Iowa Army Ammunition Plant*. October.

Tetra Tech. 2014a. Internal Draft *Line 1 Chapter Supplemental Remedial Investigation OU-6 Onsite Groundwater for Iowa Army Ammunition Plant*. November.

Tetra Tech. 2014b. Draft Final *Phase 2 Technical Memorandum and Phase 3 Work Plan Addendum Line 1 Groundwater for Iowa Army Ammunition Plant*. May.

Tetra Tech. 2014c. Draft *Work Plan for Data Gaps Investigation Operable Unit 6 for Iowa Army Ammunition Plant, Middletown, Iowa*.

Tetra Tech. 2016. Draft Final *Five-Year Review Report for Iowa Army Ammunition Plant, Middletown, Iowa*. January.

TN & Associates. 2001. Draft Final *Line 1 and Firing Site Supplemental Remedial Investigation Work Plan (Including Historical Site Assessment), Iowa Army Ammunition Plant*. August.

TN & Associates. 2002. Draft Final *Line 1 and Firing Site Supplemental Remedial Investigation*. August.

TN & Associates. 2003a. *Historical Site Assessments for Line 6, Line 800, Central Test Area, and Deactivation Furnace, Iowa Army Ammunition Plant*. September.

TN & Associates. 2003b. Draft final *Work Plan for Supplemental Remedial Design (Including Historical Site Assessment) for Phase 4 Soil Sites, Iowa Army Ammunition Plant, Middletown, Iowa*. Prepared for U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska. March.

U.S. Army EHA (Environmental Hygiene Agency). 1980. *Hazardous Waste Special Study at Iowa Army Ammunition Plant, March 3–12, 1980, Aberdeen Proving Ground, Maryland*. U.S. AEHA Control No. 8126-8211-81.

U.S. Army. 2007. *Installation Action Plan for the Iowa Army Ammunition Plant, Middletown, Iowa*.

U.S. Army. 2011. Comments on *Internal Draft Work Plan for Supplemental Investigation, Line 1, Iowa Army Ammunition Plant*. February.

U.S. Census Bureau. 2010. http://census.gov/. December.

U.S. National Library of Medicine. 2015. Hazardous Substances Data Bank. Available from: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

URS. 2003a. *Initial Groundwater Analytical Results & Proposed Monitoring Well Locations Six Sites Feasibility Study Data Collection*. February.

URS. 2003c. *Line 800 Pink Water Lagoon Feasibility Study, Iowa Army Ammunition Plant, Middletown, Iowa*. Draft Final. February.

URS. 2003b. *Groundwater Flow and Contaminant Fate and Transport Modeling Line 800 Pink Water Lagoon, Iowa Army Ammunition Plant, Middletown, Iowa*. Draft Final. February.

URS. 2004a. *Line 2 Groundwater Remedial Alternatives Analysis, Iowa Army Ammunition Plant, Middletown, Iowa*. February.

URS. 2004b. Draft *Line 3 Groundwater Remedial Alternatives Analysis, Iowa Army Ammunition Plant, Middletown, Iowa.* January.

URS. 2004c. Draft *Line 9 Groundwater Remedial Alternatives Analysis, Iowa Army Ammunition Plant*. January.

USACE. 1996. *Phytoremediation Studies: Final Report Explosives Removal from Groundwater of the IAAAP in Flow-Through Systems Planted with Aquatic and Wetland Plants*. December.

USACE. 1998. *Summary Report—Pre-Design Excavation Delineation, Lines 5A/5B, Roundhouse RDX Site, IDA Storage Yard/Burning Grounds, Omaha District*, December.

USACE. 1999. *Risk Assessment Handbook. Volume I: Human Health Evaluation.* EM 200-1-04.

USACE. 2008a. Draft Final *Iowa Army Ammunition Plant Line 1 and West Burn Pads Area South of the Road FUSRAP Remedial Design/Remedial Action Work Description, Middletown, Iowa*. July 30.

USACE. 2008b. Final *Iowa Army Ammunition Plant FUSRAP Remedial Investigation Report for Firing Sites Area, Yards C, E, F, G, and L, Warehouse 3-01 and Area West of Line 5B, Middletown, Iowa*. U.S. Army Corps of Engineers St. Louis District Office, Formerly Utilized Sites Remedial Action Program. October 9, 2008.

USACE. 2010. *Environmental Quality Risk Assessment Handbook, Volume II: Environmental Evaluation*. EM 200-1-4.

USACE. 2011a. Final *FUSRAP Feasibility Study Report for the Iowa Army Ammunition Plant, Middletown, Iowa*. April.

USACE. 2011b. Final *Iowa Army Ammunition Plant Line 1 And West Burn Pads Area South of The Road FUSRAP Remedial Design/Remedial Action Work Description Line 1 Waste Line Addendum, Middletown, Iowa*. July.

USACE. 2016. Final *Five-Year Review Report for Iowa Army Ammunition Plant, Middletown, Iowa, Defense Environmental Restoration Program*. February.

USACE. 2019a. FUSRAP Community Involvement Plan for IAAAP. https://www.mvs.usace.army.mil/Portals/54/docs/fusrap/other%20FUSRAP%20docs/IAAAP_FUSRAP_CIP_Rev0_v2_04-12-2019.pdf.

USACE. 2019b. Final *FUSRAP Five-Year Review Report for Operable Unit 1 (OU-1) and Operable Unit 8 (OU-8), Iowa Army Ammunition Plant*. March 25.

USACE. 2020. *Remedial Action Completion Report for the Formerly Utilized Sites Remedial Action Program Line 1 Structures at the Iowa Army Ammunition Plant*. August.

USACE-Baltimore. 2016. *Final Five-Year Review Report for Iowa Army Ammunition Plant, Middletown, Iowa.* February.

USACE and Dawson Solutions (U.S. Army Corps of Engineers–Kansas City District and Dawson Solutions, LLC). 2021. *Fourth Five-Year Review Report, Iowa Army Ammunition Plant, Middletown, Iowa*. Draft Final. March.

USAEC (U.S. Army Environmental Center). 1998. *Interim Action Record of Decision, Soils Operable Unit, Iowa Ammunition Plant, Middletown, Iowa*. October.

USATHAMA (U.S. Army Toxic and Hazardous Materials Agency). 1980. *Installation Assessment of Iowa Army Ammunition Plant*. Report Number 127. January.

USATHAMA (U.S. Army Toxic and Hazardous Materials Agency). 1991. Draft Final *Potential Areas of Concern Supplement, Iowa Army Ammunition Plant.* May.

USEPA. 1988. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. Interim Final *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*. Washington, D.C. EPA/540/G-85/004. OSWER Directive 9355.3-01. October.

USEPA. 1989. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A).* Office of Emergency and Remedial Response. EPA/540/1-89/002. December.

USEPA. 1998a. *Interim Action Record of Decision. Soils Operable Unit*. Iowa Army Ammunition Plant, Middletown, Iowa. March 4.

USEPA. 1998b. *EPA Superfund Record of Decision.* Iowa Army Ammunition Plant, Middletown, Iowa. EPA ID: IA7213820445. September 29.

USEPA. 1993. *Wildlife Exposure Factors Handbook.* Volume I of II. EPA/600/R-93/187a.

USEPA. 1994. *Guidance Manual for the IEUBK Model for Lead in Children.* Office of Solid Waste and Emergency Response. OSWER #9285.7-15-1. February.

USEPA. 1995. *Land Use in the CERCLA Remedy Selection Process*. OSWER Directive 9355.7-04. Office of Solid Waste and Emergency Response. Washington, D.C.

USEPA. 1996. *Soil Screening Guidance: User's Guide*. EPA/540/R-96/018. Office of Solid Waste and Emergency Response. Washington, D.C. July.

USEPA. 1997a. *Health Effects Assessment Summary Tables (HEAST)*.

USEPA. 1997b. Interim Final *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* EPA/540/R-97/006.

USEPA. 1998. *Guidelines for Ecological Risk Assessment*. Risk Assessment Forum. Washington, D.C. EPA/630/R-95/002F.

USEPA. 1999. *Ecological Risk Assessment and Risk Management Principles for Superfund Sites.* Available online at: https://www.epa.gov/risk/ecological-risk-assessment-and-risk management-principles-superfund-sites-october-1999. Accessed October.

USEPA. 2001a. *Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments).* Final. Office of Emergency and Remedial Response. 9285.7-47. December.

USEPA. 2001b. *The Role of Screening Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments.* Publication 9345.0-14. June.

USEPA. 2002. *Role of Background in the CERCLA Cleanup Program.*

USEPA. 2003a. *Region 5 RCRA Ecological Screening Levels*. Available online at: https://archive.epa .gov/region5/waste/cars/web/pdf/ecological-screening-levels-200308.pdf. Accessed August 22.

USEPA. 2003b. *Human Health Toxicity Values in Superfund Risk Assessments*. OSWER Directive 9285.7-53. December 5.

USEPA. 2004. Final *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

USEPA. 2005a. *Guidelines for Carcinogen Risk Assessment. Risk Assessment Forum.* EPA/630/P-03/001F. March.

USEPA. 2005b. *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum.* EPA/630/R-03/003F. March.

USEPA. 2006a. Freshwater Sediment Screening Benchmarks. https://www.epa.gov/risk/freshwater-sediment-screening-benchmarks.

USEPA. 2006b. Freshwater Screening Benchmarks. https://www.epa.gov/risk/freshwater-screening-benchmarks.

USEPA. 2007. *Installation Action Plan for the Iowa Army Ammunition Plant, Middletown, Iowa*.

USEPA. 2009a. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment).*

USEPA 2009b. *Provisional Peer-Reviewed Toxicity Values for Nitrotoluene, m-*. EPA/690/R-09/042F. June.

USEPA. 2010a. Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows version (IEUBK win v1.1 build 11). http://epa.gov/superfund/lead/products.htm#user.

USEPA. 2010b. *Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. Risk Assessment Forum, Washington, DC*. EPA/100/R-10/005.

USEPA 2013. *Provisional Peer-Reviewed Toxicity Values for Dinitrotoluene, 2,6-*. EPA/690/R-13/009F. April.

USEPA. 2014a. *Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120.* February.

USEPA. 2014b. *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance.* Directive 9283. 1-42.

USEPA. 2016. ProUCL software. Version 5.1.002. https://www.epa.gov/land-research/proucl-software.

USEPA. 2017a. Contaminated Site Clean-up Information: Bioremediation. August. https://clu-in.org/techfocus/default.focus/sec/Bioremediation/cat/Anaerobic_Bioremediation_(Direct)/.

USEPA. 2017b. *Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters*. OLEM Directive 9285.6-56. May.

USEPA. 2017c. *Recommendations for Default Age Range in the IEUBK Model*. OLEM Directive 9200.2-177. November.

USEPA. 2018a. Hazardous Waste Management Permit, Iowa Army Ammunition Plant. RCRA ID# IA7213820445. September.

USEPA. 2018b. *Region 4 Ecological Risk Assessment Supplemental Guidance*. March.

USEPA. 2018c. Maximum Contaminant Levels and Health Advisory Levels. March. https://www.epa.gov/dwstandardsregulations/drinking-watercontaminant-human-health-effects-information#dw-standards.

USEPA. 2019. Memorandum from Region 7 Remedial Project Manager Danny O'Connor to IAAAP Project Manager Jennifer Busard. June 10.

USEPA. 2020a. *Provisional Peer-Reviewed Toxicity Values for 2-amino-4,6-dinitrotoluene (CASRN 35572-78-2)*. EPA/690/R-20/001F. June.

USEPA. 2020b. *Provisional Peer-Reviewed Toxicity Values for 4-amino-2,6-dinitrotoluene (CASRN 19406-51-0)*. EPA/690/R-20/002F. June.

USEPA. 2021. *User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Version 2.0.* May.

USEPA. 2022a. *Regional Screening Levels for Chemical Contaminants at Superfund Sites (May 2022).* Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. Accessed May 2022.

USEPA. 2022b. Vapor Intrusion Screening Level Calculator. https://epa-visl.ornl.gov/cgi-bin/visl_search.

USEPA. 2022c. *USEPA's Integrated Risk Information System*. Available online at: https://www.epa.gov/iris. Accessed May 2022.

USEPA. 2020d. National Recommended Water Quality Criteria—Aquatic Life Criteria Table. July. https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table.

USFWS (U.S. Fish and Wildlife Service). 2018a. Iowa County Distribution of Federally Threatened, Endangered, Proposed and Candidate Species. Available online at https://www.fws.gov/midwest/endangered/lists/iowa_cty.html. Species Table listed as revised on May 18, 2017, while web page last updated on March 12, 2018.

USFWS (U.S. Fish and Wildlife Service). 2018b. *Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat*. Midwest Regional Office, Bloomington, MN. February.

Van den Berg, M., Birnbaum L.S., Denison M., De Vito M., Farland W., Feeley M., Fiedler H., Hakansson H., Hanberg A., Haws L., Rose M., Safe S., Schrenk D., Tohyama C., Tritscher A., Tuomisto J., Tysklind M., Walker N., Peterson R.E. 2006. The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds. *Toxicol. Sci.* Vol. 93, No. 2. pp. 223–241.

Tables

Table 4.2-1. Physical and Chemical Properties for Chemicals of Interest
Iowa Army Ammunition Plant, Middletown, Iowa

Chemical	Molecular Weight (g/mole)	Density (g/cm^3)	Water Solubility (mg/L)	Vapor Pressure (mm Hg)	K_h ($atm\text{-}m^3$/mole)	K_{oc} (mL/g)	K_d (mL/g)
Volatile Organic Compounds							
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	187.37	1.564	170	3.63E+02	5.26E-01	552	38.64
Chloroform	119.37	1.4788	7950	1.97E+02	3.67E-03	34	2.38
Methylene Chloride	84.93	1.326	1.32E+04	4.35E+02	3.25E-03	8	0.56
Trichloroethylene (TCE)	131.39	1.4642	1280	6.90E+01	9.02E-03	101	7.07
Semivolatile Organic Compounds/Polycyclic Aromatic Hydrocarbons							
Benzo(a)pyrene	252.32	1.351	1.62E-03	5.49E-09	4.57E-07	270,000	18,900
Bis(2-ethylhexyl) phthalate (DEHP)	390.60	0.981	2.70E-01	1.42E-07	2.70E-07	87,420	6,119
Pentachlorophenol (PCP)	266.30	1.978	1.40E+01	1.10E-04	2.45E-08	1,250	88
Naphthalene	128.17	1.162	3.10E+01	8.50E-02	4.40E-04	112	8
Explosives							
2,4-Dinitrotoluene (DNT)	182.13	—	2.70E+02	1.47E-04	5.40E-08	57	4
2,4,6-Trinitrotoluene (TNT)	227.13	1.654	1.15E+02	8.02E-06	2.10E-08	1,600	112
2,6-DNT	182.13	—	2.04E+02	5.67E-04	6.70E-07	19	1
2-amino-4,6-DNT	197.17	—	1.22E+03	3.33E-06	3.27E-11	229	16
4-amino-2,6-DNT	197.15	—	1.22E+03	3.65E-06	3.27E-11	229	16
Nitrobenzene	123.11	1.204	2.09E+03	2.45E-01	2.40E-05	30.6	2.1
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	222.12	1.820	5.97E+01	4.10E-09	2.00E-11	42	3
Octahydro-1,3,5,7-tetrazocine (HMX)	296.15		5.00E+00	2.41E-08	8.67E-10	18.9	1.3
PCBs							
Aroclor-1260	360.9	1.57	8.00E-02	4.05E-05	1.30E-05	4.8	0.3
Metals							
Aluminum	26.98	2.70	—	—	—	No Information	No Information
Antimony	121.75	6.68	—	—	—	No Information	1.3–500
Arsenic	74.92	5.78	—	—	—	No Information	2.0–20,000
Barium	137.33	3.62	—	—	—	No Information	5.0–2,500
Beryllium	9.01	1.85	—	—	—	No Information	50–13,000
Cadmium	112.40	8.69	—	—	—	No Information	1.3–100,000
Chromium	52.00	7.14	—	—	—	No Information	0.20–2,000
Cobalt	58.93	8.90	—	—	—	No Information	0.06–12,589
Copper	63.55	8.94	—	—	—	No Information	1.3–4,000
Cyanide	27.03	0.69	miscible	7.42E+02	1.33E-04	No Information	0
Iron	55.85	7.87	—	—	—	No Information	No Information
Lead	207.20	11.34	—	—	—	No Information	5.0–100,000
Manganese	54.94	7.30	—	—	—	No Information	No Information
Mercury	200.59	13.53	—	1.20E-03	—	No Information	160–630,000
Nickel	58.69	8.91	—	—	—	No Information	10–6,300
Selenium	78.96	4.81	—	1.42E-10	—	No Information	0.5–250
Silver	107.87	10.50	—	—	—	No Information	10–32,000
Thallium	204.38	11.80	—	—	—	No Information	1,000–3,200
Vanadium	50.94	6.11	—	—	—	No Information	13–500
Zinc	65.39	7.13	—	—	—	No Information	0.1–100,000

f_{oc} = fraction organic carbon = 0.07 (based on soil data collected at the IAAAP)

Kd = soil-water partition coefficient = Koc × foc for organics

K_h= Henry's Law Constant

K_{oc} = Organic carbon partition coefficient

— = No value is provided because of the uncertainty in the form of these chemicals in the environment.

Data Sources:

Hazardous Substances Data Bank. 2020. National Library of Medicine (U.S.). Bethesda, MD. Available from:

USACE. 2015. *Technical Guidance for Military Munitions Response Actions* . October.

USEPA. 2020a. Regional Screening Levels. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

USEPA. 2005. *Partition Coefficients for Metals in Surface Water, Soil, and Waste* . July.

Table 4.3-2. Exposure Media and Potential Receptor Scenarios Evaluated in Human Health Risk Assessments for IAAAP Sites Included in This Report
Iowa Army Ammunition Plant, Middletown, Iowa

Site		Media[a]									
		Surface Soil			Total Soil			Groundwater			Sediment and Surface Water
		Hunter/ Recreator	Site Worker	Hypothetical Resident	Site Worker	Construction Worker	Hypothetical Resident	Site Worker	Construction Worker[b]	Hypothetical Resident	Hunter/ Recreator
Line 1		—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X	X	X	—[d]
Line 1 Impoundment		—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X	X	X	X[e,f]
Line 2	Onsite	—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X	X	X	—[d]
	Offsite	—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X	X	X	—[d]
Line 3		—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X	X	X	—[d]
Line 3A		—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X[h]	X[h]	X	—[d]
Lines 5A/5B	Line 5A	—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X	X	X	—[d]
	Line 5B	—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X[h]	X[h]	X	—[d]
Line 800/ Pink Water Lagoon		—[c,g]	—[c,g]	—[c,g]	—[c,g]	—[c,g]	—[c,g]	X	X	X	—[d, g]
Line 9		—[c]	—[c]	—[c]	—[c]	—[c]	—[c]	X	X	X	—[d]

X = media/receptor evaluated in the HHRA[a]

— incomplete pathway; therefore media/receptor not evaluated in HHRA

[a] Potential exposures to soil and groundwater are only estimated for a hunter/recreator, site worker and construction/utility worker if the estimated risks for a hypothetical residential scenario exceed acceptable risk levels and COCs are identified for a residential scenario.

[b] Construction worker was only evaluated for groundwater less than 10 feet below ground surface when culverts are present on site.

[c] Soil addressed under OU1.

[d] No perennial surface water bodies present.

[e] No COPCs were identified.

[f] An interim remedy is in place for the impoundment surface water and sediment; therefore they were not evaluated in the HHRA. Surface water and sediment from Brush Creek are evaluated.

[g] An interim remedy is in place for the Pinkwater Lagoon soil, surface water, and sediment; therefore they were not evaluated in the HHRA.

[h] Potential exposures to this receptor were not quantified because the estimated risks for a hypothetical residential scenario did not exceed acceptable risk levels and COCs were not identified for a residential scenario. The hypothetical resident exposures and potential health risks and hazards are considered protective of other receptors.

Table 4.3-3. General Uncertainties in Human Health Risk and Ecological Risk Assessments for IAAAP Sites Included in This Report

Iowa Army Ammunition Plant, Middletown, Iowa

Category	Assumption/Description	Probable Effect on Risk and Hazard Estimates
	Human Health	
Data Evaluation		
Data used in the HHRA	Historical samples were included in the HHRA; however, it is possible the historical data may not be representative of current site conditions.	May under- or overestimate risks and hazards
Selection of COPCs	RSLs for hexavalent chromium were used to screen total chromium concentrations; however, it is unlikely 100 percent of the total chromium detected in site media is in the hexavalent state.	Certainly overestimates risks and hazards
	Some detected chemicals do not have SLs and were not identified as COPCs.	Likely underestimates risks and hazards
	Some chemicals reported to be 100 percent nondetect had reporting limits exceeding SLs. Some SL exceedances occur because reporting limits are elevated due to available analytical methods. Other SL exceedances by reporting limits occur because chemical toxicities result in corresponding SL being below QAPP-specified reporting limits.	May underestimate risks and hazards
Exposure Assumptions		
Selection of exposure scenarios and exposure pathways	Assumed that residents access site media in the future.	Overestimates actual future risks and hazards
	Assumed the current concentrations remain the same for hypothetical future scenarios.	May under- or overestimate risks and hazards
Use of the UCL on the arithmetic mean as the EPC.	Receptors are assumed to be exposed to the UCL on the mean concentrations for the entire exposure duration.	Likely overestimates risks and hazards
Exposure factors	Exposure factors used for quantitation of exposure are conservative and reflect a combination of average and worst-case or upper-bound assumptions to represent a reasonable maximum exposure scenario.	Likely overestimates risks and hazards
Toxicity Assessment		
Carcinogenic slope factors	Slope factors represent upper-bound estimates	Likely overestimates risk and hazards
ADAFs for COPCs that act with MMOA	Chemical-specific ADAFs were not available	May under- or overestimate risk

Table 4.3-3. General Uncertainties in Human Health Risk and Ecological Risk Assessments for IAAAP Sites Included in This Report
Iowa Army Ammunition Plant, Middletown, Iowa

Category	Assumption/Description	Probable Effect on Risk and Hazard Estimates
Risk Characterization		
Risk from multiple chemicals	Assumes additivity of risks from multiple chemicals; chemical mixtures may actually have synergistic or antagonistic effects.	May under- or overestimate risks and hazards
Risk from soil	Site worker risks from soil addressed under OU-1 are not incorporated into cumulative risks for media addressed in this OU. USEPA makes decisions on a matrix-specific basis. Note that remedial goals for RDX and TNT in soil under OU-1 are based on leachability goals for protection of groundwater.	May underestimate risks
Ecological		
Data Evaluation		
Data used in the SLERA	Historical samples were included in the SLERA; however, it is possible the historical data may not be representative of current site conditions.	May under- or overestimate risk
Nondetected data	Some ESVs are less than reporting limits	May underestimate risks
Selection of COPECs	Some ESVs do not account for bioaccumulation through the food chain.	Likely underestimates risks
Exposure Assumptions		
Selection of exposure scenarios and exposure pathways	Assumed the current concentrations remain the same in the future.	May under- or overestimate risks
Area Size	Assumed area is large enough to evaluate ecological risks. Evaluation of small areas is conservative.	May overestimate risks
Use of the maximum detected concentrations (MDC) as the EPC.	Receptors are assumed to be exposed to the MDC for the entire exposure duration.	May overestimate risks
Toxicity Assessment		
Ecological Screening Values	ESVs represent conservative screening levels	Likely overestimates risk
Risk Characterization		
Risk from multiple chemicals	Assumes additivity of risks from multiple chemicals; chemical mixtures may actually have synergistic or antagonistic effects.	May under- or overestimate risks

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Line 1 Impoundment Embankment and Sediment Removal (Dames & Moore, 1989b)	1957	The embankment creating the impoundment and some explosives-contaminated sediment were removed.	Most of the explosives-contaminated sediment remained in the impoundment area.
Hazardous Waste Special Study (U.S. Army EHA, 1980)	1980	Sediment samples were collected at unknown locations within Brush Creek and analyzed for explosives.	TNT and RDX were detected at 30,454 mg/kg and 53,671 mg/kg, respectively.
Installation Assessment of IAAAP (USATHAMA, 1980)	1980	A records search was conducted to assess the use, storage, treatment, and disposal of toxic and hazardous materials at IAAAP regarding environmental quality.	Line 1 was a missile warhead, cartridge, and grenade LAP facility. From 1948 to June 30, 1975, Line 1 was operated as the Burlington AEC/ERDA plant. From interviews, it was determined that, during the AEC period, Line 1 was the greatest generator of explosives waste and pinkwater. A follow-on preliminary survey was recommended to define the level of contaminants which may be migrating beyond the installation boundaries.
Underground Pollution Investigation (SCS, 1982)	1981	Two surface water samples (Nos. 1 and 2) were collected and analyzed for explosives, SVOCs, metals, pesticides, herbicides, and radionuclides. Sediment (waste residue) samples were collected and analyzed for explosives, SVOCs, metals, pesticides, and PCBs. Five monitoring wells were installed at the Line 1 Impoundment. Groundwater samples were collected from locations Z1-1, Z1-2A, Z1-3, and Z1-6 on three consecutive days and analyzed for explosives (11 samples), SVOCs (8 samples), metals (12 samples), pesticides (12 samples), herbicides (8 samples), and radionuclides (8 samples).	Metals and explosives were generally not detected in sediment, and no exceedances of groundwater quality criteria were detected. It was concluded that environmental impacts were limited to sediment and media in contact with sediment.
Contamination Survey (ERG, 1982)	1982	Sediment and surface water were collected from one location (W-9) and analyzed for explosives, metals, pesticides, and PCBs. Four soil samples were collected at S-7 through S-10 and analyzed for explosives, metals, pesticides, and PCBs. One monitoring well (G-14) was installed, and a groundwater sample was collected and analyzed for explosives, metals, pesticides, and PCBs.	RDX was detected in sediment, surface water, and groundwater. No details were provided regarding the results of the soil sampling. Further delineation of detected explosives was recommended.

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Follow-on Study of Environmental Contamination (Battelle, 1984)	1984	Five sediment samples were collected from SE-46 through SE-50 and analyzed for explosives and metals. Two surface water samples were collected from W-51 and W-52 and analyzed for explosives and metals. Five groundwater samples were collected from GZ-1, GZ-2, GZ-2A, GZ-3, and G-14 and analyzed for explosives, VOCs, and metals.	Explosives were detected in sediment, with higher concentrations present toward the south end of the impoundment. Explosives were also detected in surface water, but the source was not identified. RDX was detected in GZ-2 and GZ-2A; it was concluded that shallow groundwater recharging Brush Creek in the impoundment area was contaminated with RDX from sediments in the impoundment.
Midwest Site Confirmatory Study (Dames & Moore, 1986)	1986	Groundwater samples were collected at GZ-1, GZ-2, GZ-2A, GZ-3, GZ-6, and GZ-14 and analyzed for explosives, VOCs, and metals.	RDX and HMX were detected in shallow groundwater at Line 1.
Endangerment Assessment/FS, Line 1 Impoundment and Line 800 Pinkwater Lagoon (Dames & Moore, 1989a, 1989b)	1987	One surface water sample and an unknown number of sediment samples were collected and analyzed for explosives and metals. Fourteen soil samples were collected at SL-79 through SL-92 and analyzed for explosives and metals. An unknown number of groundwater samples was collected and analyzed for explosives and metals.	RDX and HMX were detected in the surface water sample and in sediment samples and soil samples to depths of 2 feet bgs. Additional explosives were detected in sediment. RDX and HMX also were detected in monitoring wells GZ-2 and GZ-2A. Metals were not detected in groundwater, but barium was present in soil at concentrations similar to those present sitewide.
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	1991	A preliminary assessment was conducted for the contaminated waste processor to evaluate the potential for contamination and assess potential migration pathways and exposure potential if contamination were present.	Releases of TNT, lead azide, barium nitrate, mercury fulminate, PBX, and antimony sulfate to the environment may have occurred during historical site operations at Line 1. Sampling was recommended around the buildings known to generate or treat hazardous wastes to determine whether past discharges, spills, and leaks persist in the environment.
Facility-wide Site Inspection (JAYCOR, 1992)	1991	Six soil samples (one grab and five composite) were collected in the areas of the buildings known to generate or treat hazardous waste: oil and solvent storage (0-03-3); melt buildings (1-05-1, 1-05-2); carbon filter buildings (1-70-1); and load and storage areas. Three sediment samples and one surface water sample were collected from associated drainages. Most samples were analyzed for VOCs, SVOCs, explosives, metals, and radionuclides.	VOCs, SVOCs, explosives, metals, and radionuclides were detected in site samples. Elevated levels of metals (lead, barium, cadmium, chromium, and zinc) and explosives (2,4,6-TNT, HMX, and RDX) were observed in the Line 1 production area. It was recommended that Line 1 be included in the Remedial Investigation.

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Facility-wide Phase I and Follow-on Remedial Investigation (JAYCOR, 1993a, 1996)	1992–1995	Forty-nine soil samples were collected and analyzed for explosives, VOCs, SVOCs, pesticides, explosives, and metals. Additional screening-level soil samples were analyzed for metals (839 samples) and explosives (364 samples). Thirty-one of the explosives screening samples and 73 of the metals screening samples were sent to a fixed laboratory for confirmation. Four soil samples were also collected within the Line 1 Impoundment site boundary as part of a Brush Creek study and analyzed for explosives, metals, and VOCs; it is unknown what report these samples were documented in.	Explosives compounds were detected around buildings, and metals were detected throughout the site. Soil contamination at the sumps was typically noted to extend 10–20 feet below the center of the sump and 3 feet below the bottom of the sump in the immediate vicinity of the sumps.
		Soil gas samples were collected from 5 to 7 feet bgs at 37 locations near solvent storage Building 1-03-5. Soil gas samples were collected from 42 locations near aboveground storage tanks. These samples were submitted for VOC analysis. Continuous soil cores were collected from 5 to 37 feet at 14 locations throughout the site during monitoring well installation and headspace was screened with a PID. A sample was collected from each location at the depth with the greatest PID readings and send to a laboratory for metals and explosives analysis. An additional two soil gas samples were collected at 5 and 10 feet bgs at JAW-601 and analyzed for metals and explosives.	Only nine of the soil gas samples near Building 1-03-5 and four of the soil gas samples around the storage tanks had VOCs detected, with maximum total VOC concentrations of 18.037 ppm and 4.031 ppm, respectively. Headspace readings at the continuous sampling locations and samples collected at JAW-601 indicated low levels of VOCs (maximum 4 ppm). The results of lithology logging efforts identified a low-permeability till unit underlying the more permeable loess at near surface depths, with a hydraulic conductivity of 5.8×10^{-9} cm/s determined by laboratory analysis in the till.
		Surface water samples were collected from five sample locations at the site and analyzed for explosives, VOCs, SVOCs, metals, and radionuclides. An additional two surface water samples were collected from Building 1-05-1 and analyzed for explosives, VOCs, SVOCs, and metals.	Localized metals (lead, chromium, and silver) and explosives (RDX, HMX, 2.4.6-TNT, 1,3,5-TNB, 2,6-DNT) were detected in sediment and surface water at NPDES discharges, associated drainageways, and sumps. Explosives in surface water and sediment in the impoundment area were considered the result of buildup in depressional areas over time or the erosion of contaminated surface soil/sediment from the Line 1 embankment.
		Sediment samples were collected from 10 locations throughout the site and analyzed for explosives, VOCs, SVOCs, metals, and radionuclides. Three sediment samples were collected from the basement of Building 1-05-1 and two samples were collected from sumps in Buildings 1-05-2 and 1-01 and analyzed for explosives, VOCs, SVOCs, and metals.	

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
		Two piezometers were installed and sampled for VOCs and SVOCs. Fourteen overburden monitoring wells (JAW-38 through JAW-48, JAW-50 through JAW-52) and three bedrock monitoring wells (JAW-601 through JAW-603) were installed and sampled for explosives and metals. The bedrock wells also were sampled for VOCs, SVOCs, pesticides, PAHs, and PCBs. Groundwater samples were also collected at SL-81 and SL-91 and analyzed for explosives, VOCs, SVOCs, and metals. Ten more piezometers were installed and sampled for metals, with eight of the piezometers also sampled for explosives.	Metals and explosives were detected in groundwater samples, with metals detected in 17 monitoring wells. VOC detects were less prevalent, and the clay geology at the site appears to act as an aquitard to limit vertical migration to groundwater. The lateral extent of groundwater contamination was limited to the south/southeast side of the melt buildings. The RI recommended semiannual compliance groundwater monitoring at Line 1 for explosives and metals for compliance with the hazardous waste management regulations for permitted facilities (40 CFR Part 264), specifically, Subpart F of these regulations, "Releases from Solid Waste Management Units."
Periodic Groundwater and Surface Water Monitoring (multiple reports)	1994–2008	Periodic groundwater and surface water sampling was conducted at Line 1 and the Line 1 Impoundment per the FFA and recommendations in the 1996 RI. Samples were analyzed for explosives and metals. Samples were occasionally analyzed for radionuclides.	Explosives and metals were detected in groundwater samples collected from wells screened within the shallow and deep zones of the overburden aquifer. Groundwater plumes were generally stable, and evidence of biological degradation was noted. Neither gross alpha nor gross beta exceeded screening levels when last analyzed, in 2006. During the last event in 2008, the highest concentration of RDX was reported at 16.4 µg/L at Line 1 and 4,170 µg/L at the former Line 1 Impoundment. Total arsenic was detected at 13.6 µg/L in deep groundwater at Line 1.
Baseline Human Health and Ecological Risk Assessment, Former Line 1 Impoundment and Pink Water Lagoon (JAYCOR and ICAIR, 1994)	1994	The 1989 Endangerment Assessment report was rewritten to incorporate USEPA comments on the original document and more-current baseline risk assessment approaches that are in accordance with "Risk Assessment Guidance for Superfund Volumes I and 2" (EPA/5401I/89/002).	The revised risk assessment concluded that soil/sediment at the Line 1 Impoundment potentially posed risks in excess of 10^6, with RDX being the primary risk driver.
Engineering Evaluation/Cost Analysis for the Pink Water Lagoon and the Line I Impoundment (CDM, 1994)	1994	Removal action alternatives were evaluated for the Pink Water Lagoon and the Line 1 Impoundment areas. Non-time-critical removal actions were evaluated for these sites prior to completion of the feasibility study process to reduce human exposure and any further impact to groundwater.	The Engineering Evaluation/Cost Analysis recommended Alternative 1: Excavation and Storage in an RCRA Waste Pile for the Line 1 Impoundment. This alternative included excavation of contaminated soil and sediment and segregation based on the measured levels of contaminants. The report noted that the final remedy will be selected when the feasibility study for remedial alternatives addressing the entire site is completed.

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Sump Removal Action (OHM, 1996)	1995	Eleven sumps were removed from Buildings 1-05-1, 1-08-1, 1-12, 1-40, and 1-50. Approximately 206.5 cubic yards of soil and material was removed.	Confirmation samples were taken and analyzed for metals and explosives prior to backfilling.
Phytoremediation Study (Best et al., 1998)	1996	A study was performed to quantify the ability of three submerged and emergent macrophytes, when planted in local sediment under flow-through conditions, to phytoremediate explosives-contaminated groundwater at IAAAP.	Recommendations for the use of aquatic and wetland plants in constructed wetlands were provided. The plants can provide a carbon supply for TNT- and/or RDX-degrading microorganisms. The direct removal of explosives by plant uptake and subsequent metabolization, and the possibility that plant-specific leachates photosensitize explosives and selectively stimulate explosives-degrading microorganisms were suggested during the study but not demonstrated.
Action Memorandum for the Line 800 Pinkwater Lagoon, Former Line 1 Impoundment (CDM, 1996)	1996	The memorandum described the removal action selected for the Line 800 Pinkwater Lagoon and Former Line 1 Impoundment, and summarized the site evaluation, which supported the implementation of a removal action.	The Action Memorandum served as the primary decision document for the removal conducted at the Line 800 Pinkwater Lagoon and Former Line 1 Impoundment. More than 100,000 cubic yards of explosives contaminated soil and sediment was proposed for removal at the Line 1 Impoundment and Pinkwater Lagoon. The removal action also included the diversion of Brush Creek, a permanent diversion dam and the creation of a wetland for phytoremediation.
Interim Remedial Action for Line 1 Impoundment (ECC, 2001a)[a]	1996–2000	Approximately 12,225 cubic yards of contaminated soil and sediment was removed from the former Line 1 impoundment in 1997. During the remedial action, Brush Creek was permanently rerouted west of the former Line 1 impoundment, and the excavated impoundment was converted into a pond and wetland. A permanent hydraulic control structure was constructed for hydraulic relief of the remediated Line 1 impoundment area to Brush Creek. A building to house a granular activated treatment system for impounded water and a water treatment building were also constructed in 1998 and 1999, respectively, and the Line 1 lower outlet structure was opened in 1998.	The remedial action removed a substantial amount of source material contaminating the upper reaches of Brush Creek. A grouted drop structure was constructed across the Brush Creek diversion channel to ensure that the Line 1 Impoundment water surface elevation remains below the water surface elevation of Brush Creek, thereby preventing any contaminated water in the impoundment from seeping into Brush Creek. Confirmation samples verified that removal action goals were met. Operation and maintenance activities were defined in the remedial action report and included: granular activated carbon water treatment, sampling and analysis of the granular activated carbon treatment unit, phytoremediation monitoring, sampling and analysis of monitoring wells, gas vents, and gas probes, erosion control, mowing, and other maintenance.

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Supplemental Remedial Investigation (MWH, 2001)	1997	Three sediment samples from two locations and one surface water sample were collected from area 7E, located in the upstream reaches of Brush Creek near the north boundary of Line 1 to assess Brush Creek. Soil and groundwater samples were collected around Building 1-03-05 and Line 1 Tank Farm to assess for the presence of VOCs.	In sediment, methylene chloride and RDX were detected. In surface water, methylene chloride, RDX, and HMX were detected. Freon was detected in soil samples, but was attributed to cross-contamination. Toluene was detected in groundwater samples. Near the tank farm, substituted benzene compounds were detected in soil and groundwater samples. Trace levels of 1,1-dichloroethane, 1, 1-dichloroethene, and cis-l,2-dichloroethene were also detected.
Phytoremediation Monitoring Line 1 and Line 800 (Phytoworks, 1999)	1998	Baseline sampling was conducted in sediment and surface water and plant tissue to assess whether phytoremediation was occurring at the former Line 1 Impoundment and Line 800 Pinkwater Lagoon. Eight samples were collected from sediment in the Line 1 lagoon area and analyzed for explosives. Plant and water samples also were collected, but information on number of samples and analysis is limited. A sample location map is not available.	The data indicated plant species at Lines 1 and 800 were destroying TNT and its degradation products, but although plants were concentrating RDX and HMX, the data were inconclusive whether the plants were destroying or simply sequestering RDX and HMX. RDX was detected in all sediment samples, with results ranging from 200 to 7,250 µg/kg. HMX, 4-amino-2,6-DNT, 2-amino-4,6-DNT, and TNT were also detected in one or more sediment samples, although at lower concentrations than RDX.
Interim Action Record of Decision for Soils Operable Unit (USAEC, 1998)	1998	The selected interim remedial actions for contaminated soils at 15 areas at IAAAP were presented.	The Interim Action ROD specified that the most highly contaminated soils, which included the Line 1 Impoundment and Pinkwater Lagoon, would be stockpiled in the onsite Corrective Action Management Unit.
USEPA Superfund OU-1 Record of Decision (Department of the Army and USEPA, 1998)	1998	The Final ROD for OU-1 was issued to address contaminated soils at IAAAP. The ROD presented the selected remedial action for OU-1.	The selected remedy included excavation for soil contaminated with metals, explosives, SVOCs, and radionuclides at Line 1.
Sump Removal Action at Building 1-05-2 (ECC, 2001a)	1999–2000	Sixty-three soil samples were collected at the north sump, and 51 soil samples were collected at the south sump prior to define the excavation areas. Samples were analyzed for explosives, RCRA metals, VOCs, and SVOCs. Approximately 60 cubic yards of soil contaminated with explosives and inorganics were removed from a sump area at the north end of Building 1-05-2.	Five-point confirmation samples were taken from each sidewall and from the bottom of the excavations around the north sump. Confirmation data indicated the sump excavations removed all soil above screening levels. No further action was warranted for the south sump aquifer the soil characterization phase.
Line 1 and Firing Site Supplemental Remedial Investigation (TN & Associates, 2002)	2001–2002	Hundreds of soil samples were collected around Line 1 buildings to identify areas of contamination in support of future remedial designs/investigations for removal of contaminated material.	RDX, indeno(1,2,3-cd)pyrene, and metals (barium, arsenic, lead, and silver) were detected above preliminary remediation goals. The most exceedances were observed near melt Building 1-05-2, research and development Building 1-60, and filter Building 1-70.

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Sump and Clarifier Removal Line 1 (TN & Associates, 2002; USACE, 2008a)	2002–2007	During a site walkthrough conducted in 2002, it was observed that the sump at Building 1-10 had been removed; no records exist regarding details of the removal. Similarly, during a site walkthrough in 2007, clarifiers were not present at Buildings 1-05-1, 1-05-2, and 1-10 even though historical drawings indicate that clarifiers had been installed at these buildings; there are no records regarding their removal.	Based on site walkthroughs, one sump and three additional clarifiers were removed at Line 1.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	2005	A comprehensive evaluation was conducted of all IAAAP sites and the four primary watersheds (Brush Creek, Spring Creek, Long Creek, and Skunk River) to identify data gaps and additional data needed to complete a feasibility study for surface water and groundwater at each of the IAAAP sites.	The work plan concluded that soil and sediment runoff may contribute to the contamination in Brush Creek; however, this would be addressed under FUSRAP. It was noted that investigation of groundwater and surface water interactions would take place as part of the Brush Creek surface water and sediment investigation work plan for OU-4, and investigation of groundwater data gaps would also occur as part of a facility-wide work plan.
Pre-Supplemental Remedial Investigation Sampling (Tetra Tech, 2014a)	2006–2009	In 2006, four DPT groundwater samples were collected following the recommendations in the CWWP. One DPT groundwater sample was collected in the vicinity of Building 1-70, where RDX was detected in soil above the OU-1 RG, one DPT groundwater sample was collected to the west of the Line 1 Impoundment, and one DPT groundwater sample was collected to the south of the Line 1 Impoundment. Based on the results, the fourth DPT groundwater sample was collected west (downgradient) of the Building 1-70 sample. All samples were analyzed for explosives. In 2009, surface water samples were collected after a rainfall event from drainages discharging into Brush Creek and from sump drainages at Building 1-10, west of Building 1-61, west of Building 1-07E, and north of Building 1-64-4 as part of the on-post Brush Creek tributary investigation. Samples were analyzed for explosives.	Several explosives were detected in the DPT groundwater samples collected adjacent to and downgradient from Building 1-70. Explosives were not detected in the sample collected at the southern boundary of the Line 1 Impoundment site. HMX and RDX were detected in the sample collected to the west of the impoundment; however, concentrations were below screening levels. Results of surface water sampling from Line 1 drainages in August 2009 indicated the highest RDX concentrations were at the downstream ends of the south-central ephemeral ditch (122 µg/L) and the north-central ephemeral ditch (52.2 µg/L) immediately prior to discharging to Brush Creek.

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Remedial Action for OU-1 Soils (USACE, 2008b; Tetra Tech, 2009a; USACE, 2019b)	2009–2013	Soil contaminated with explosives, SVOCs, PCBs, and/or inorganics was removed from multiple excavations at Line 1 under OU-1. For the FUSRAP work, exposure units were defined to facilitate the excavations. An exposure unit is defined as a geographic area in which a future receptor is assumed to work and where a receptor may be exposed to chemicals of concern.	Soil with concentrations above OU-1 RGs was removed with five exceptions: RDX concentrations above human health RGs at EU7-E (Buildings 1-12 and 1-82-3) and EU9B-B (Building 1-70), and RDX concentrations above leaching RGs at EU5-E (terminated below groundwater table), EU6-A (blast berm), and EU7-D (steam pipe foundation). During the removals, the portion of the contaminated water collection system underground piping near Building 1-70 was removed and the ends capped.
DPT Groundwater Sampling (USACE, 2011b)	2010–2011	Seven groundwater samples were collected from temporary borings as part of a FUSRAP investigation of the waste lines that ran from Buildings 1-100, 1-10, and 1-12 to Building 1-70. Samples were analyzed for explosives. The depth of the groundwater samples is unknown.	Four explosives (RDX, HMX, TNT, and 1,3,5-trinitrobenzene) were detected. RDX was the most frequently detected and highest-concentration contaminant.
FUSRAP OU-8 Record of Decision (USACE, 2019b)	2011	ROD document under FUSRAP identifying the selected remedy to address radioactive surface contamination on structures at Line 1 and in soil and structures at the FSA. Radioactive contaminants were not detected in soil at Line 1 at levels of concern.	The Selected Remedy for soil and structures at the FUSRAP sites addressed by the ROD (Line 1 structures, and soil and structures at the FSA areas) is excavation of DU-contaminated soil with physical treatment and offsite disposal, and decontamination/replacement of structures. The Selected Remedy includes continued land use controls to prevent inappropriate (non-industrial) use of the site and CERCLA 5-year reviews to verify industrial land use continues.
Phase I Supplemental Remedial Investigation (Tetra Tech, 2012b)	2011–2012	Thirty temporary groundwater wells were installed and sampled for explosives; 27 of the wells were also sampled for metals. Surface water samples were also collected from 26 locations and analyzed for explosives.	RDX was detected above screening criteria in groundwater, sediment, and surface water. RDX comprises the primary groundwater contaminant plumes, although other explosives are present within the RDX plumes. The RDX plumes are delineated, with a maximum depth of 30 feet bgs; further vertical migration is

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Phase II Supplemental Remedial Investigation (Tetra Tech, 2014b)	2012–2013	Thirty temporary groundwater wells were installed; 29 were sampled for explosives, and 27 of the wells were also sampled for metals. Surface water samples were also collected from 23 locations and sediment samples were collected from 7 locations. Samples were analyzed for explosives. One sump water sample was collected and analyzed for explosives. Sediment samples were collected from six locations and analyzed for explosives.	limited by the low permeability till geology. Concentrations of RDX in groundwater have decreased over time. The HHRA concluded that there were unacceptable risks for the industrial worker. Cancer risk drivers included RDX, 2,4,6-TNT, 2-nitrotoluene, arsenic, and chromium. Noncancer health effects drivers included RDX and total manganese. Cancer risks and noncancer health effects were within the acceptable target range for contractor construction/utility worker and the maintenance/utility worker.
Phase III Supplemental Remedial Investigation (Tetra Tech, 2014c)	2014	Seven temporary groundwater wells and one permanent groundwater monitoring well were installed and sampled for explosives and metals. Surface water samples were collected from 45 locations; 46 locations were analyzed for metals and 33 locations were analyzed for metals. A HHRA was conducted for three potential receptors: the contractor construction/utility worker, the employee maintenance/utility worker, and the industrial worker.	
FUSRAP Structures Remediation at Line 1 (USACE, 2020)	2014–2016	Buildings 1-63-6 and 1-11 were surveyed and decontaminated. The steel floor grate covering the sump at Building 1-11 was replaced.	A verification process was conducted for the Line 1 structures to ensure that any residual radioactivity complied with the requirements of the FUSRAP ROD (USACE 2011). The results of the final status survey analytical data demonstrate that the Line 1 structures meet the FUSRAP ROD criteria for industrial use.

Table 5.1-1. Previous Investigations and Remedial Actions—Line 1 and Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Line 1 Impoundment and Line 800 Lagoon Operations and Maintenance Plan (Aerostar, 2016)[a]	2016	Regular operations and maintenance (O&M) activities are required to sustain the proper functionality of the interim remedial actions at the Line 1 Impoundment and the Pink Water Lagoon. This plan provided detailed information for O&M activities, standard operating procedures, email notifications.	The following O&M activities were planned for the Line 1 Impoundment: Water surface elevation within the Line 1 Impoundment shall be evaluated weekly and after significant rain events. A four-point composite water sample shall be collected from the impoundment for offsite laboratory analysis to determine if a direct release or a treatment system release should be conducted. If a direct release occurs, then weekly sampling should be conducted at the point of discharge. If a treatment release is conducted, then weekly sampling should be conducted from the effluent sampling port. Monthly samples should be collected from the influent port and after the first carbon unit. Bag filter sampling and spent carbon sampling may also be needed. O&M activities should also be conducted on the remedial action structures.
Explanation of Significant Differences for the Records of Decision Soils OU-1 (Leidos, 2018)	2018	Documented the addition of LUCs to the selected remedy for the soils ROD to provide overall protectiveness of human health and the environment.	The Explanation of Significant Differences changes will apply to soil at Line 1.
OU-1 Land Use Controls Implementation Plan (Leidos, 2019)	2019	Outlined the process for implementation and maintenance of LUCs as a component of the selected remedy for OU-1. Institutional controls will be used to restrict land use at OU-1 Areas to military, commercial/industrial, agricultural, and permitted hunting and prohibit residential use. Engineering controls (fencing, signs) will be used to prevent general access to areas.	The scope of the LUCIP applies to the Line 1.
FUSRAP Post-Demolition Remedial Investigation (USACE, 2019b)	2019–ongoing	Under the FUSRAP program, soil samples were collected at the demolished Building 1-05-1, Building 1-55-1, and Building 1-70 areas and analyzed for explosives to assess if contamination is present within the former building footprints.	No explosives were detected above RGs or ecological criteria in soil samples collected within the former building footprints. Additional soil sampling is planned for the future and soil excavations may be conducted based on the results.
Sediment Removal at Line 1 Impoundment (PARS-Gannett Fleming, 2020)	2020–ongoing	Sediment removal is being conducted at the Line 1 Impoundment to restore capacity of the impoundment, which has been reduced due to sedimentation.	It is estimated that 2,100 cubic yards of sediment will be removed from the impoundment pond and disposed of. This is expected to increase the capacity of the impoundment and reduce solids collecting in the Line 1 Impoundment treatment system bag filters to achieve more efficient treatment rates.

[a] O&M activities were initiated for the interim remedial action at the Line 1 Impoundment in 2000. These activities occur on a weekly to annual basis and are not included in this table.

Table 5.1-3. Monitoring Well Construction Details—Line 1

Iowa Army Ammunition Plant, Middletown, IA

Well Location	Screen Interval (feet bgs)	Filter Pack Interval (feet bgs)	Borehole Depth (feet bgs)	Well Casing Diameter (inches)	Top of Casing Elevation (feet amsl)
L1-MW102	15 to 25	13 to 25	25	2	710.51
L1-MW103	20 to 30	18 to 30	30	2	713.63
L1-MW104	15 to 25	13 to 25	25	2	713.79
L1-MW105	15 to 25	13 to 25	25	2	715.99
L1-MW106	10 to 20	8 to 20	20	2	719.45
L1-MW107	15 to 25	13 to 25	25	2	715.46

Notes:

Borehole diameter was 8 inches for monitoring wells L1-MW102, -MW103, -MW104, -MW105, and -MW106 and 6 inches for monitoring well L1-MW107.

amsl = above mean sea level

bgs = below ground surface

Table 5.1-4. Gauging Information—Line 1

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval (ft btoc)	Depth to Water (ft btoc)	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)
JAW-38	11/13/2018	5-10	7.21	696.52	689.31
JAW-39	11/13/2018	7-12	7.12	695.22	688.1
JAW-40	11/13/2018	10-20	4.04	695.84	691.8
JAW-41	11/13/2018	5-15	7.04	694.56	687.52
JAW-42	11/13/2018	5-10	5.06	689.82	684.76
JAW-45	11/13/2018	8-13	6.87	705.72	698.85
JAW-46	11/13/2018	5-10	5.88	697.11	691.23
JAW-47	11/13/2018	13-18	5.69	711.57	705.88
JAW-48	11/13/2018	30-44	7.91	704.18	696.27
JAW-50	11/13/2018	12-22	9.27	716.85	707.58
JAW-51	11/13/2018	9-19	7.09	717.89	710.8
JAW-52	11/13/2018	10-20	7.64	720.16	712.52
JAW-602	11/13/2018	87.5-97.5	32.45	713.91	681.46
JAW-603	11/13/2018	87-97	26.17	717.42	691.25
L1-MW1	11/13/2018	25-35	9.13	719.02	709.89
L1-MW102	11/13/2018	15-25	5.73	710.514	704.784
L1-MW103	11/14/2018	20-30	Frozen	713.637	NA
L1-MW104	11/13/2018	15-25	6.08	713.79	707.71
L1-MW105	11/13/2018	15-25	4.78	715.992	711.212
L1-MW106	11/13/2018	10-20	3.37	719.459	716.089
L1-MW107	11/13/2018	15-25	9.33	715.469	706.139
L1-TTMW-100	11/14/2018	32-37	4.96	NM	NA
L1-TTMW-101	11/14/2018	30-35	5.3	NM	NA

Notes:

ft = feet

btoc = below top of casing

amsl = above mean sea level

NA = Not Available

NM = Not Measured

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	IA92-12 (L1-MW-UNK1)	IAAP132578	IAAP132590	IAAP132602	IAAP135624	IAAP135684	IAAP135732	IAAP135774	JAW-38	
					Sample ID	L1-MW-UNK1-11182012	IAAP132615	IAAP132617	IAAP132619	IAAP135820	IAAP135821	IAAP135822	IAAP135823	F04-GW-064	JAW-38-5002014
					Sample Depth (ft)	7.5 - 10	unknown	unknown	unknown	unknown	unknown	unknown	unknown	5 - 10	5 - 10
					Sample Date	11/18/2020	12/7/2010	12/7/2010	12/7/2010	4/13/2011	4/13/2011	4/14/2011	4/14/2011	11/17/2004	5/6/2014
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	160000	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	6000	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1000 U	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	190 U	- -	- -	- -	- -	- -	- -	- -	- -	220 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1000 U	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	7000	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	200 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	440	- -	- -	- -	- -	- -	- -	- -	- -	33 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	147000	- -	- -	- -	- -	- -	- -	- -	24000	19700
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.2 U	0.7	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.48 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.53	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.1	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.48 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.48 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.15 J
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.2
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	110	17	60	2	0.59	13	8.9	0.48 U	0.19 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*4.6*	*470*	*280*	*2.4*	0.52	1.2	*17*	*13*	0.48 U	0.19 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	0.48 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -	62.7 B	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	20 U	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	99.3 B	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	44000	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	1.3 B	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	37.4 B	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	29 U	- -	- -	- -	- -	- -	- -	- -	- -	17 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	3.7 B	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	13100	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	71.8	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	2.5 B	- -	- -	- -	- -	- -	- -	- -	- -	3.9 B
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	0.2 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	10 U	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	7650 E	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	40 U	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1.3	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1
Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	JAW-39								JAW-40	
					Sample ID	JAW-39-050500	JAW-39-20001022	JAW-39-20010529	JAW-39-20020617	JAW-39-20030604	F04-GW-065	JAW-39-5002014	JAW-39-5002014-FD	JAW-40-050500	JAW-40-20001023
					Sample Depth (ft)	7 - 12	7 - 12	7 - 12	7 - 12	7 - 12	7 - 12	7 - 12	7 - 12	10 - 20	10 - 20
					Sample Date	5/5/2000	10/22/2000	5/29/2001	6/17/2002	6/4/2003	11/17/2004	5/6/2014	5/6/2014	5/5/2000	10/23/2000
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	170000	150000	160000	170000	180000	- -	- -	- -	370000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	10	10 U	10 U	20 U	- -	- -	- -	- -	20
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	26000	200000	70000	14000	7000	- -	- -	- -	45000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	1000 U	1000 U	1000 U	- -	230 B	220 U	- -	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	300 U	300 U	300 U	300	- -	- -	- -	- -	300
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	1000 U	1000 U	1000 U	1200	1000 U	- -	- -	- -	1000 U
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	5500	6000	7000	8000	8000	- -	- -	- -	2000
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	200 U	50 U	50 U	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	10 U	20	10 U	50 U	- -	33 U	33 U	- -	80
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	26000	24000	25000	25000	25000	21500	21600	- -	11000
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.16 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.16 U	1.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.83 U	0.81 U	0.96 U	0.97 U	0.49 U	0.19 U	0.19 U	- -	1.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.16 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.16 U	1.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.16 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.16 U	1.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.31 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.31 U	1.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.31 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.31 U	1.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.31 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.31 U	1.1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.31 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.31 U	1.1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.78 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.78 U	1.1 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	0.49 U	0.19 U	0.19 U	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	0.49 U	0.19 U	0.19 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.39 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.39 U	1.1 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.16 U	0.78 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.16 U	1 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.31 U	0.83 U	0.65 U	0.77 U	0.97 U	0.49 U	0.19 U	0.19 U	0.31 U	1.1 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	106 B	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.4 U	10 U	10 U	10 U	10 U	20 U	- -	- -	2.4 U	10 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	66.7	78.9 J	97.4 J	81 J	113 J	112 B	- -	- -	142	138 J
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	5 U	0.3 J	5 U	5 U	0.6 B	- -	- -	0.4 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	44100	43100	- -	- -	46800	- -	- -	- -	81700
METALS	7440-47-3	Chromium	µg/L	100	31	7 J	1.2 J	1 J	10 U	2.3 J	0.9 B	- -	- -	12.6	10 U
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	68 B	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	- -	- -	- -	- -	17 U	18.8 B	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	1.7 U	10 U	10 U	10 U	10 U	10 U	- -	- -	1.7 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	14100	15300	- -	- -	15900	- -	- -	- -	26900
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	31.2	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	- -	- -	- -	- -	*518*	*514*	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	0.21 U	0.21 U	0.2 U	0.02 J	0.2 U	- -	- -	0.1 U	0.21 U
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	10 U	10 U	10 U	3.8 J	2.6 B	- -	- -	2.6 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	10 U	10 U	10 U	10 U	10 U	- -	- -	2.8 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	7030	7270	- -	- -	7700 E	- -	- -	- -	23000
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	26.4 B	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	0.3 J	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-40							
					Sample ID	JAW-40-20010531	JAW-40-20020618	JAW-40-20030603	F04-GW-066	F05-JAW-40-GW-REG	S06-JAW-40-GW-REG	F06-JAW-40-GW-REG	S07-L1-JAW-40-GW-REG
					Sample Depth (ft)	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20
					Sample Date	5/31/2001	6/18/2002	6/3/2003	11/17/2004	9/29/2005	4/12/2006	8/31/2006	6/5/2007
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	350000	380000	390000	390000	367000	6500	205000	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	20	10 U	70	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	75000	170000	24000	5000	372000	44100	267000	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	10000	1000 U	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	300	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	3400	2200	500 U	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	2000	2000	2000	1000	2100	6900	21200	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	200 U	580	410	2300	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	70	70	70	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	12000	11000	12000	12000	12700	15700	39500	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.6 U	1 U	0.79 U	0.48 U	0.2 U	0.2 U	0.27	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.31	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	0.48 U	0.2 U	0.2 U	0.19 U	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.3 U	0.82 U	0.79 U	0.22 JP	0.2 U	0.2 U	13.9	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	*15.3*	0.19 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.3 U	0.82 U	0.79 U	0.48 U	0.2 U	0.2 U	0.19 U	- -
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	35.7 B	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	10 U	10 U	20 U	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	144 J	129 J	150 J	152 B	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	*9.8*	5 U	0.51 U	0.6 B	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	87000	- -	- -	86300	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	10 U	10 U	0.93 B	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	56.5 B	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	10 U	10 U	2.9 B	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	27400	- -	- -	29000	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	27.3	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	10 U	10 U	10 U	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	10 U	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	22700	- -	- -	31100 E	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	40 U	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	0.63 J	0.5 U	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-40				JAW-41			JAW-42		JAW-45	
					Sample ID	S08-JAW-40-GW-REG	JAW-40-5002014	JAW-40-1118	F04-GW-067	JAW-41-5002014	JAW-41-1118	F04-GW-063	JAW-42-5002014	JAW42-1118	JAW-45-050500	JAW-45-20010604
					Sample Depth (ft)	10 - 20	10 - 20	10 - 20	5 - 15	5 - 15	5 - 15	5 - 10	5 - 10	5 - 10	8 - 13	8 - 13
					Sample Date	5/6/2008	5/7/2014	11/15/2018	11/18/2004	5/7/2014	11/16/2018	11/17/2004	5/13/2014	11/15/2018	5/5/2000	6/4/2001
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])											
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	380000	- -	- -	140000	- -	- -	- -	240000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	3600	- -	- -	- -	- -	- -	- -	30000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	1000 U	- -	- -	1000 U	- -	- -	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	220 U	- -	- -	220 U	- -	- -	220 U	- -	- -	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	1700	- -	- -	1000	- -	- -	- -	1000 U
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	1000	- -	- -	12000	- -	- -	- -	2000
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	200 U	- -	- -	200 U	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	82 B	- -	- -	57 B	- -	- -	33 U	- -	- -	760
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	10900	- -	3000	12300	- -	18000	9700	- -	- -	24000
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.16 U	1.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	- -	1.4 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.16 U	1.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.16 U	1.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.31 U	1.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.31 U	1.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	- -	0.19 U	0.2 UJ	0.49 U	0.19 U	0.2 UJ	0.49 U	0.19 U	0.2 UJ	0.31 U	1.1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.31 U	1.1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	- -	0.19 U	0.2 UJ	0.49 U	0.19 U	0.2 UJ	0.49 U	0.19 U	0.2 UJ	0.78 U	1.1 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	0.19 U	0.2 UJ	0.49 U	0.19 U	0.2 UJ	0.49 U	0.19 U	0.2 UJ	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	0.19 U	0.1 UJ	0.18 JP	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.39 U	1.1 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.16 U	1.1 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	- -	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.49 U	0.19 U	0.1 UJ	0.31 U	1.1 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	593	- -	- -	35.9 B	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	7.2 B	- -	- -	20 U	- -	- -	2.4 U	10 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	595	- -	- -	84.2 B	- -	- -	55.9	67.1 J
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	0.58 B	- -	- -	5 U	- -	- -	0.4 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	82900	- -	- -	37400	- -	- -	- -	61500
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	2 B	- -	- -	0.85 B	- -	- -	1.8 U	0.8 J
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	2800	- -	- -	30.4 B	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	17 U	- -	- -	130 B	- -	- -	205 B	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	10 U	- -	- -	2.6 B	- -	- -	1.7 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	27100	- -	- -	15700	- -	- -	- -	26300
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	*4300*	- -	- -	32.3	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	1 U	- -	- -	*568*	- -	- -	2.8 B	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	0.2 U	- -	- -	0.2 U	- -	- -	0.1 U	0.21 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	3.6 B	- -	- -	10 U	- -	- -	2.6 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	10 U	- -	- -	10 U	- -	- -	2.8 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	22600 E	- -	- -	6320 E	- -	- -	- -	10100
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	12 B	- -	- -	17.9 B	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	73	- -	- -	0.87 U	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-45			JAW-46		JAW-47		JAW-48		
					Sample ID	JAW-45-20020616	JAW-45-20030602	JAW-45-5002014	JAW-46-5002014	JAW-46-5002014-FD	JAW-47-5002014	JAW-47-1118	JAW-48-050600	JAW-48-20001022	JAW-48-20010604
					Sample Depth (ft)	8 - 13	8 - 13	8 - 13	5 - 10	5 - 10	13 - 18	13 - 18	30 - 44	30 - 44	30 - 44
					Sample Date	6/16/2002	6/2/2003	5/9/2014	5/12/2014	5/12/2014	5/13/2014	11/15/2018	5/6/2000	10/22/2000	6/4/2001
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	250000	250000	- -	- -	- -	- -	- -	- -	440000	460000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	80	- -	- -	- -	- -	- -	- -	4200	4100
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	110000	25000	- -	- -	- -	- -	- -	- -	22000	45000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	- -	- -	- -	- -	- -	- -	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	920	1200	220 U	710 B	- -	- -	1000 U	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	- -	- -	- -	- -	- -	- -	5600	5100
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000 U	- -	- -	- -	- -	- -	- -	13000	14000
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	2000	2000	- -	- -	- -	- -	- -	- -	1000 U	1000
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	840	360	9200	260	320	3400	- -	- -	50 U	50
ANIONS	14808-79-8	Sulfate	µg/L	--	--	28000	31000	62300	26400	26400	13200	- -	- -	2000	1000 U
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.22 U	0.58 U	0.44 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.3 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	- -	0.58 U	0.55 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.22 U	0.58 U	0.44 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.22 U	0.58 U	0.44 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.44 U	0.58 U	0.44 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.44 U	0.58 U	0.44 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.21 UJ	0.44 U	0.58 U	0.44 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.44 U	0.58 U	0.44 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.21 UJ	1.1 U	0.58 U	0.44 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	0.19 U	0.19 U	0.19 U	0.19 U	0.21 UJ	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.55 U	0.58 U	0.44 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.22 U	0.55 U	0.44 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.1 U	0.88 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.44 U	0.58 U	0.44 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	10 U	- -	- -	- -	- -	- -	*14.1*	*14.6*	*16.5*
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	57.8 J	62 J	- -	- -	- -	- -	- -	513	538	588
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	0.51 U	- -	- -	- -	- -	- -	0.4 U	5 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	77500	79400
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	10 U	- -	- -	- -	- -	- -	1.9 J	1.1 J	0.7 J
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	17 U	17 U	17 U	70.6 B	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	10 U	- -	- -	- -	1.1 U	- -	1.7 U	1.6 J	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	30500	31600
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	1 U	1.5 B	1.4 B	17.3	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.2 U	0.2 U	- -	- -	- -	- -	- -	0.1 U	0.21 U	0.21 U
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	10 U	- -	- -	- -	- -	- -	2.6 U	10 U	2.6 J
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	- -	- -	- -	- -	- -	2.8 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	38400	45100
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-48						JAW-50		
					Sample ID	JAW-48-20020611	JAW-48-20030602	F05-JAW-48-GW-REG	S06-JAW-48-GW-REG	F06-JAW-48-GW-REG	JAW-48-5002014	JAW-50-050500	JAW-50-20001022	JAW-50-20010604
					Sample Depth (ft)	30 - 44	30 - 44	30 - 44	30 - 44	30 - 44	30 - 44	12 - 22	12 - 22	12 - 22
					Sample Date	6/11/2002	6/2/2003	9/29/2005	4/11/2006	8/31/2006	5/12/2014	5/5/2000	10/22/2000	6/4/2001
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])									
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	430000	440000	- -	- -	- -	- -	- -	410000	390000
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	3700	3900	- -	- -	- -	- -	- -	10 U	10 U
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	190000	38000	- -	- -	- -	- -	- -	120000	60000
GENERAL	14265-44-2	Phosphate	μg/L	--	--	1000 U	1000 U	- -	- -	- -	- -	- -	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	μg/L	--	--	16000	1000 U	- -	- -	- -	530 B	- -	1000 U	1000 U
GENERAL	TDS	Total dissolved solids	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	4900	6100	- -	- -	- -	- -	- -	300 U	300 U
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	13000	13000	- -	- -	- -	- -	- -	1200	1000 U
GENERAL	TSS	Total suspended solids	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	1000	1000 U	- -	- -	- -	- -	- -	4600	6000
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	10 U	50 U	- -	- -	- -	33 U	- -	20	90
ANIONS	14808-79-8	Sulfate	μg/L	--	--	1000 U	1000 U	- -	- -	- -	600 U	- -	32000	35000
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.16 U	1 U	0.39 U
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	1 U	0.38 U	- -	- -	- -	0.19 U	- -	2.3	1.1 J
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.16 U	1 U	0.39 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	μg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.16 U	1 U	0.39 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	μg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.31 U	1 U	0.39 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.31 U	1 U	0.39 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.31 U	1 U	0.39 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.31 U	1 U	0.39 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.78 U	1 U	0.39 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	- -	- -	- -	- -	0.19 U	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	- -	- -	- -	0.19 U	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	3.1	4	1.1
EXPLOSIVES	2691-41-0	HMX, dissolved	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	*19*	*38*	*13*
EXPLOSIVES	121-82-4	RDX, dissolved	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.81 U	0.38 U	- -	- -	- -	0.19 U	0.31 U	1 U	0.39 U
METALS	7429-90-5	Aluminum	μg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	*15*	*19.2*	*13.1*	*25.6*	*17.5*	- -	2.4 U	10 U	10 U
METALS	7440-38-2	Arsenic, dissolved	μg/L	10	--	- -	- -	2.9 U	7.1 B	2.8 U	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	507 J	523	- -	- -	- -	- -	166	179 J	189 J
METALS	7440-43-9	Cadmium	μg/L	5	5	5 U	5 U	- -	- -	- -	- -	0.4 U	5 U	0.6 J
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	93300	99400
METALS	7440-47-3	Chromium	μg/L	100	31	10 U	10 U	- -	- -	- -	- -	1.8 U	0.4 J	10 U
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	μg/L	14000	--	- -	- -	- -	- -	- -	162 B	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	10 U	10 U	- -	- -	- -	- -	1.7 U	1.9 J	10 U
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	41000	42200
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	μg/L	430	--	- -	- -	- -	- -	- -	*824*	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	0.2 U	0.02 J	- -	- -	- -	- -	0.1 U	0.21 U	0.21 U
METALS	7782-49-2	Selenium	μg/L	50	10	10 U	10 U	- -	- -	- -	- -	2.6 U	10 U	10 U
METALS	7440-22-4	Silver	μg/L	130	10	10 U	10 U	- -	- -	- -	- -	2.8 U	10 U	10 U
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	12900	14000
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	μg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	μg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-50								
					Sample ID	JAW-50-20010604-FD	JAW-50-20020611	JAW-50-20030602	F04-GW-002	F05-JAW-50-GW-REG	S06-JAW-50-GW-REG	F06-JAW-50-GW-REG	S07-JAW-50-GW-REG	S08-JAW-50-GW-FD
					Sample Depth (ft)	12 - 22	12 - 22	12 - 22	12 - 22	12 - 22	12 - 22	12 - 22	12 - 22	12 - 22
					Sample Date	6/4/2001	6/11/2002	6/2/2003	11/10/2004	9/29/2005	4/12/2006	9/5/2006	6/5/2007	5/6/2008
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	400000	390000	400000	400000	320000	400000	425000	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	10 U	30	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	45000	170000	65000	4500	374000	623000	500000	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	9000	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	300 U	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000	1000 U	1000 U	1200	1600	800 J	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	6000	6000	5000	4000	3500	9400	8700 J	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	200 U	120	120	130 J	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	90	50 U	50 U	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	36000	39000	38000	34000	36800	32300	33000 J	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.1	0.55 U	0.77 J	1.5	2.1	0.87	1.9	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	0.57	0.97	0.42	0.8	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	0.51	0.59	0.25	0.47	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.2	1.3	1.7	3.2	4.2	2.1	3.9	- -	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*15*	*16*	*14*	*34*	*45.7*	*18.3*	*36.5*	*27*	*16.9*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.32 U	0.44 U	0.44 U	0.51 U	0.2 U	0.2 U	0.2 U	- -	- -
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	500 U	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	10 U	10 U	20 U	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	193	191 J	194 J	193 B	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	5 U	0.31 U	0.51 B	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	98500	- -	- -	91500	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	0.4	10 U	10 U	0.76 B	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	93.3 B	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	10 U	10 U	3 B	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	42200	- -	- -	40900	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	25.8	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	10 U	3.4 J	3 B	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	13900	- -	- -	14000 E	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	40 U	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	0.87 U	0.5 U	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location			JAW-51						JAW-52	
					Sample ID	S08-JAW-50-GW-REG	JAW-50-5002014	JAW-51-050500	JAW-51-20001022	JAW-51-20010604	JAW-51-20020611	JAW-51-20030602	JAW-51-5002014	JAW-52-5002014	JAW-52-1118
					Sample Depth (ft)	12 - 22	12 - 22	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	10 - 20	10 - 20
					Sample Date	5/6/2008	5/8/2014	5/5/2000	10/22/2000	6/4/2001	6/11/2002	6/2/2003	5/8/2014	5/6/2014	11/14/2018
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	250000	240000	240000	210000	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	20	- -	10 U	20 U	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	5500	34000	110000	26000	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	720 B	- -	1000 U	1000 U	16000	1000 U	1100	220 U	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	300	300 U	300 U	300 U	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	1000 U	2000	1000	1000	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	250	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	33 U	- -	30	100	40 U	70	1800	330	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	33000	- -	25000	24000	28000	32000	104000	16200	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	0.19 U	0.16 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.75	- -	0.74 U	1.1 U	1.1 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	0.19 U	0.16 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	0.19 U	0.16 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	- -	0.19 U	0.31 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	0.19 U	0.31 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	- -	0.19 U	0.31 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.2 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	0.19 U	0.31 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	- -	0.19 U	0.78 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.2 UJ
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	0.19 U	- -	- -	- -	- -	- -	0.19 U	0.19 U	0.2 UJ
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.11 J	- -	- -	- -	- -	- -	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	1.9	0.39 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*16.4*	*13.6*	0.16 U	0.7 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	- -	0.19 U	0.31 U	0.74 U	0.84 U	0.91 U	0.94 U	0.19 U	0.19 U	0.1 UJ
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	2.4 U	10 U	10 U	10 U	10 U	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	73.7	64.6 J	69 J	62.4 J	65.9 J	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	0.4 U	5 U	0.6 J	5 U	0.7 U	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	57900	62300	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	3.6 J	1.9 J	0.3 J	10 U	0.72 J	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	17 U	- -	- -	- -	- -	- -	17 U	17 U	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	1.7 U	2.7 J	10 U	10 U	10 U	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	20000	23700	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	2.1 B	- -	- -	- -	- -	- -	1 U	2 B	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	5.9	4.2 J	12	8.2 J	5.2 J	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	2.8 U	10 U	10 U	10 U	10 U	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	10900	12000	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-602							
					Sample ID	JAW-602-050600	JAW-602-20001130	JAW-602-20010618	JAW-602-20020611	JAW-602-20030601	F05-JAW-602-GW-REG	S06-JAW-602-GW-REG	F06-JAW-602-GW-REG
					Sample Depth (ft)	87.5 - 97.5	87.5 - 97.5	87.5 - 97.5	87.5 - 97.5	87.5 - 97.5	87.5 - 97.5	87.5 - 97.5	87.5 - 97.5
					Sample Date	5/6/2000	11/30/2000	6/18/2001	6/11/2002	6/1/2003	10/11/2005	4/12/2006	9/7/2006
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	390000	390000	380000	360000	243000	403000	388000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	2400	3300	2300	1900	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	70000	60000	- -	25000	265000	571000	453000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	1000 U	- -	1000 U	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	2900	3200	2500	3100	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	3700	3400	3300	3300	2900	1200	2900
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	1300	1000 U	1000	1000	1000 U	6500	6900
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	50 U	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	10 U	130	10 U	50 U	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	1800	1000	2000	23000	1400 B	9000	8200
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.16 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	1.1 U	0.78 U	1.2 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.16 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.16 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.31 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.31 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.31 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.31 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.78 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	0.19 U	0.2 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	0.19 U	0.2 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.39 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.16 U	0.99 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.31 U	1.1 U	0.62 U	0.99 U	0.7 U	0.19 U	0.2 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	*24.5*	*25.1*	*27.9*	8.1 J	*25.3*	*21.4*	*10.8*	*17.6*
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	*23.1*	7.1 B	*12.2*
METALS	7440-39-3	Barium	µg/L	2000	430	338	365	401	317 J	371	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	5 U	5 U	5 U	5 U	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	62800	64600	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	1.8 U	1.6 J	10 U	10 U	10 U	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	1.7 U	10 U	10 U	10 U	10 U	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	23500	26800	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	0.21 U	0.21 U	0.2 U	0.02 J	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	10 U	3.3 J	10 U	10 U	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	10 U	10 U	10 U	10 U	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	52200	54700	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	4630	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1
Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-602			JAW-603				
					Sample ID	S07-L1-JAW-602-GW-REG	S08-JAW-602-GW-REG	JAW-602-5002014	JAW-603-050600	JAW-603-20001201	JAW-603-20010619	JAW-603-20020612	JAW-603-20030604
					Sample Depth (ft)	87.5 - 97.5	87.5 - 97.5	87.5 - 97.5	87 - 97	87 - 97	87 - 97	87 - 97	87 - 97
					Sample Date	6/6/2007	5/7/2008	5/15/2014	5/6/2000	12/1/2000	6/19/2001	6/12/2002	6/4/2003
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	410000	410000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	130	20
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	180000	32000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	220 U	- -	- -	- -	9000	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	1200	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	1700	1100 U
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	6000	6000
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	33 U	- -	- -	- -	360	380
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	990 B	- -	- -	- -	48000	45000
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	- -	0.19 U	0.16 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.19 U	- -	0.87 U	1.1 U	0.52 U	1.3 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	- -	0.19 U	0.16 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	- -	0.19 U	0.16 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	- -	- -	0.19 U	0.31 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	- -	0.19 U	0.31 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	- -	- -	0.19 U	0.31 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	- -	0.19 U	0.31 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	- -	- -	0.19 U	0.78 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	0.19 U	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	0.19 U	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	0.19 U	0.39 U	0.87 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	- -	0.35	0.16 U	0.82 U	0.87 U	0.42 U	1.3 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	- -	- -	0.19 U	0.31 U	0.87 U	0.87 U	0.42 U	1.3 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	*13.6*	- -	2.4 U	10 U	4 J	10 U	10 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	9.3 J	6.4 J	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	124	109 J	1100	92.5 J	122 J
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	0.4 U	0.3 J	5 U	5 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	1.8 U	1.3 J	1.2 J	0.79 J	2.5 J
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	203 B	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	1.7 U	10 U	2.7 J	10 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	219	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	0.1 U	0.21 U	0.21 U	0.2 U	0.03 J
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	2.6 U	10 U	2.6 J	10 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	2.8 U	10 U	10 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-603	L1-MW1							
					Sample ID	JAW-603-5002014	L1MW1-011100	L1-MW1-050600	L1-MW1-20001023	L1-MW1-20010530	L1-MW1-20020612	L1-MW1-20030603	F05-L1-MW1-GW-REG	S06-L1-MW1-GW-REG
					Sample Depth (ft)	87 - 97	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35
					Sample Date	5/8/2014	1/11/2000	5/6/2000	10/23/2000	5/30/2001	6/12/2002	6/3/2003	9/30/2005	4/11/2006
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	563000	- -	390000	370000	390000	380000	249000	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	440 UJ	- -	80	50	150	40	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	505000	- -	50000	65000	170000	46000	265000	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	1200	- -	1000 U	1000 U	1000 U	1000 U	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	920	1400	- -	4000	1000 U	2000	1000 U	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	880 UJ	- -	1500	700	500	300	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	620 U	- -	1300	2500	1200	1000 U	1000	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	10300	- -	2900	2000	2000	2000	1000 U	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	280	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	33 U	50 U	- -	140	30	140	170	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	43300	38300	- -	35000	43000	36000	39000	28600	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.03 UC	0.19 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.2 U	- -	- -	0.47 U	1.1 U	1.2 U	0.34 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	0.04 U	0.19 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.05 U	0.19 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	0.05 U	0.31 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.03 U	0.37 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.06 U	0.37 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.02 U	0.37 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.06 U	0.94 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.2 U	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.2 U	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.2 U	0.06 U	0.47 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.2 U	0.05 U	0.16 U	0.44 U	0.9 U	0.96 U	0.34 U	- -	- -
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	0.03 UJ	0.37 U	0.47 U	0.9 U	0.96 U	0.34 U	- -	- -
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	*165*	5.9 J	10 U	10 U	10 U	13.6 U	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	*3080*	243	127 J	143 J	122 J	301	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	46 U	0.6 J	5 U	0.5 J	5 U	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	1140000	- -	90300	90000	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	*550*	52.9	1.5 J	0.9 J	9.4 J	44.4	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	17 U	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	*310*	9.8	10 U	10 U	3.4 J	*18.2*	*20.9*	2.4 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	288000	- -	30600	33300	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	107	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.99	0.1 U	0.21 U	0.21 U	0.2 U	0.03 J	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	10	2.6 U	10 U	10 U	10 U	5.7 J	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	1.1 U	2.8 U	10 U	0.4 J	10 U	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	31500	- -	25900	29100	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	950	42.2	- -	- -	- -	- -	13.9	4.9
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	5.3	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	1020	41.8	- -	- -	- -	- -	8.7	3.4
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	9.8	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	1.72	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1
Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-MW1		L1-MW102	L1-MW103	L1-MW104	L1-MW105	L1-MW106	L1-MW107	
					Sample ID	F06-L1-MW1-GW-REG	L1-MW1-5002014	L1-MW102-1118	L1-MW103-0319	L1-MW104-1118	L1-MW-105-1118	L1-MW106-1118	L1-MW107-1118	LI-MW107-1118
					Sample Depth (ft)	25 - 35	25 - 35	15 - 25	20 - 30	15 - 25	15 - 25	10 - 20	15 - 25	15 - 25
					Sample Date	9/5/2006	5/19/2014	11/15/2018	3/25/2019	11/15/2018	11/15/2018	11/15/2018	11/16/2018	11/16/2018
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	230 B	- -	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	120	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	29200	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	0.19 U	0.1 UJ	0.41 U	0.1 UJ	0.1 UJ	0.1 UJ	- -	0.1 UJ
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.16 J	0.1 UJ	1.2	0.1 UJ	0.1 UJ	0.098 J	- -	0.1 UJ
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	0.19 U	0.1 UJ	0.41 U	0.1 UJ	0.1 UJ	0.1 UJ	- -	0.1 UJ
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	0.19 U	0.1 UJ	0.21 U	0.1 UJ	0.1 UJ	0.1 UJ	- -	0.1 UJ
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	- -	0.19 U	0.1 UJ	0.21 U	0.1 UJ	0.1 UJ	0.1 UJ	- -	0.1 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	0.19 U	0.1 UJ	0.12 U	0.1 UJ	0.1 UJ	0.1 UJ	- -	0.1 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	- -	0.19 U	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	- -	0.2 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	0.19 U	0.1 UJ	0.12 U	0.1 UJ	0.1 UJ	0.1 UJ	- -	0.1 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	- -	0.19 U	0.2 UJ	0.41 U	0.2 UJ	0.2 UJ	0.2 UJ	- -	0.2 UJ
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	0.19 U	0.2 UJ	0.26 U	0.2 UJ	0.2 UJ	0.2 UJ	- -	0.2 UJ
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.19 U	0.1 UJ	0.84 J	0.1 UJ	0.1 UJ	0.1 UJ	- -	0.1 UJ
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	8.1	0.053 J	11	0.1 UJ	0.1 UJ	0.16 J	- -	0.1 UJ
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	*4.2*	0.096 J	*22*	0.1 UJ	0.1 UJ	1.1 J	- -	0.086 J
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	- -	0.19 U	0.1 UJ	0.21 U	0.1 UJ	0.1 UJ	0.1 UJ	- -	0.1 UJ
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	17 U	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	1.7 U	1.1 U	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	*545*	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	4.6	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	2.8	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	0.34 J	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	3.2	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	0.14 J	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	19	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	0.16 J	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	0.46 J	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	0.43 J	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTMW-100			L1-TTMW-101		L1-TTTW-002	L1-TTTW-004
					Sample ID	L1-TTMW-100-6132013	L1-TTMW-100-5002014	L1-TTMW-100-1118	L1-TTMW-101-5002014	L1-TTMW-101-1118	L1-TTTW-002	L1-TTTW-004
					Sample Depth (ft)	32 - 37	32 - 37	32 - 37	30 - 35	30 - 35	20 - 24	3 - 18
					Sample Date	6/13/2013	5/19/2014	11/15/2018	5/14/2014	11/15/2018	11/5/2006	12/19/2006
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	270 B	- -	- -	1100	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	42 B	- -	- -	33 U	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	6400	- -	- -	21600	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.19 U	0.11 UJ	0.2 U	0.1 UJ	3	0.075 J
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	0.19 U	0.11 UJ	0.2 U	0.1 UJ	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.19 U	0.11 UJ	0.2 U	0.1 UJ	*6.8*	0.075 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.19 U	0.11 J	0.2 U	0.1 UJ	0.2 U	0.075 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.19 U	*0.086 J*	0.2 U	0.1 UJ	0.2 U	0.075 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.19 U	0.11 UJ	0.2 U	0.1 UJ	*3*	0.075 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.19 U	0.23 UJ	0.2 U	0.2 UJ	0.2 U	0.075 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.19 U	0.11 UJ	0.2 U	0.1 UJ	*2.8*	0.075 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.19 U	0.23 UJ	0.2 U	0.2 UJ	0.2 U	0.075 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	0.19 U	0.23 UJ	0.2 U	0.2 UJ	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	0.19 U	0.11 UJ	0.2 U	0.1 UJ	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	0.19 U	0.6 J	0.2 U	0.1 UJ	59.1	6.68
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	0.19 U	0.11 UJ	0.2 U	0.1 UJ	*236*	*90*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.19 U	0.11 UJ	0.2 U	0.1 UJ	0.2 U	0.075 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	67 B	- -	- -	149 B	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	272	- -	- -	*639*	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-009			L1-TTTW-010	L1-TTTW-011	
					Sample ID	L1-TTTW-009-12152011	L1-TTTW-009-12152011-FD3	L1-TTTW-009-5002014	L1-TTTW-010-12152011	L1-TTTW-011-11192011	L1-TTTW-011-11212011
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	12/15/2011	12/15/2011	5/10/2014	12/15/2011	11/19/2011	11/21/2011
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])						
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	300 U	300 U	- -	300 U	300 U	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	500	530	- -	430	50 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	17400 J	19600 J	- -	11800	34400	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	29 U	29 U	2.4	0.19 U	0.55	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	44 J	40 J	51.4	2.3 J	5.3	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	*11.5 J*	29 U	0.19 U	0.19 U	0.66	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	29 U	29 U	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	29 U	29 U	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	29 U	29 U	*3.8*	0.5	0.14 J	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	29 U	29 U	*0.59*	0.19 U	*13.1*	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	29 U	29 U	*6.5*	1.3	0.43	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	29 U	29 U	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	12.1 J	13.5 J	12.4	0.95 U	1.5 U	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	14.7 J	15.5 J	11.9	0.56	0.76 U	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	105	103	83.9	37.7	11	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*1860*	*1790*	*2050*	*52.9*	*40.3*	- -
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	29 U	29 U	0.19 U	0.19 U	0.19 U	- -
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	263 J	35 U	- -	2730 J	- -	35 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	9.2 J	8.8 J	- -	275 J	- -	255
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-012		L1-TTTW-013		L1-TTTW-014	
					Sample ID	L1-TTTW-012-11192011	L1-TTTW-012-11212011	L1-TTTW-013-11192011	L1-TTTW-013-11212011	L1-TTTW-014-11192011	L1-TTTW-014-11212011
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	11/19/2011	11/21/2011	11/19/2011	11/21/2011	11/19/2011	11/21/2011
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[(1)])						
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	300 U	- -	300 U	- -	480 J	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	50 U	- -	50 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	28500	- -	39100	- -	21800	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	36.7	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.6	- -	0.38 U	- -	0.19 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	*34.2*	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	*10.9*	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	*25.9*	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	5.1 J	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	7.3	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	45.1	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*133*	- -	0.19 U	- -	0.19 U	- -
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	- -	0.19 U	- -	0.19 U	- -
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	35 U	- -	35 U	- -	87.7 J
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	330	- -	392	- -	*673*
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1
Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-015		L1-TTTW-016			L1-TTTW-017	
					Sample ID	L1-TTTW-015-11192011	L1-TTTW-015-11212011	L1-TTTW-016-11192011	L1-TTTW-016-11212011	L1-TTTW-016-5002014	L1-TTTW-017-11182011	L1-TTTW-017-5002014
					Sample Depth (ft)	12 - 22	12 - 22	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	11/19/2011	11/21/2011	11/19/2011	11/21/2011	5/11/2014	11/18/2011	5/10/2014
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95(1))							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	300 U	- -	330 J	- -	- -	300 U	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	540	- -	46 J	- -	- -	970	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	71000	- -	26300	- -	- -	16900	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	- -	0.19 U	- -	0.19 U	0.2 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.69	- -	5.3	- -	2	2.1	3.2
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	- -	0.19 U	- -	0.19 U	0.2 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	- -	0.19 U	- -	0.19 U	0.2 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	- -	0.19 U	- -	0.19 U	0.2 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	- -	0.19 U	- -	0.19 U	0.31	0.35
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	- -	0.19 U	- -	0.19 U	0.2 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	- -	0.19 U	- -	0.19 U	0.38	0.48
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	- -	0.17 J	- -	0.19 U	0.2 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	- -	1.7 J	- -	1.4	0.93	1.9
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	- -	1.5	- -	0.44	0.24	0.34
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	5.2	- -	8.8	- -	4	3.5	5.9
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*7.7*	- -	*105*	- -	*53.5*	*74.6*	*179*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	- -	0.19 U	- -	0.19 U	0.2 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	35 U	- -	35 U	- -	35.2 J	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	106	- -	192	- -	101	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1
Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-017	L1-TTTW-018	L1-TTTW-019	L1-TTTW-020	L1-TTTW-021	
					Sample ID	L1-TTTW-017-5002014-FD	L1-TTTW-018-02072012	L1-TTTW-019-11182011	L1-TTTW-020-11182011	L1-TTTW-021-11192011	L1-TTTW-021-11212011
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	5/10/2014	2/7/2012	11/18/2011	11/18/2011	11/19/2011	11/21/2011
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])						
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	420 J	300 J	- -	- -
GENERAL	TDS	Total dissolved solids	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	μg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	57 J	470	1400	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	- -	- -	23500	12300	- -	28200
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.19 U	0.35	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	3.3	0.32	0.61	0.19 U	0.28	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.19 U	*4.2*	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	μg/L	2.5	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	μg/L	0.24	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.42	*4.2*	0.27	0.12 J	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.49	*28.7*	0.69	0.32	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	1.5	0.19 U	1.2	0.19 U	0.36 J	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.36	0.19 U	0.56	0.19 U	0.19 U	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	5.4	4.3	1.6	0.42	11.7	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	μg/L	1000	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	*188*	*10.3*	*8.6*	0.72	*9*	- -
EXPLOSIVES	121-82-4	RDX, dissolved	μg/L	2	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -
METALS	7429-90-5	Aluminum	μg/L	20000	11272	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	μg/L	10	--	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	μg/L	14000	--	- -	- -	35 U	35 U	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	μg/L	430	--	- -	- -	*477*	44.1	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	μg/L	18000	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	μg/L	80	--	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-022		L1-TTTW-023			
					Sample ID	L1-TTTW-022-11192011	L1-TTTW-022-11212011	L1-TTTW-023-11192011	L1-TTTW-023-11192011-FD2	L1-TTTW-023-11212011	L1-TTTW-023-11212011-FD2
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	11/19/2011	11/21/2011	11/19/2011	11/19/2011	11/21/2011	11/21/2011
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])						
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	300 U	- -	300 U	370 J	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	610	- -	50 U	50 U	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	26700	- -	29800	27700	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	2.3	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*3.7*	- -	0.19 U	0.19 U	- -	- -
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	- -	0.19 U	0.19 U	- -	- -
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	35 U	- -	- -	35 U	35 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	406	- -	- -	*1870*	*1880*
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
					Location	L1-TTTW-024		L1-TTTW-025		L1-TTTW-026	L1-TTTW-027	L1-TTTW-028
					Sample ID	L1-TTTW-024-11162011	L1-TTTW-024-11162011-FD1	L1-TTTW-025-11182011	L1-TTTW-025-5002014	L1-TTTW-026-11182011	L1-TTTW-027-02072012	L1-TTTW-028-11182011
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	11/16/2011	11/16/2011	11/21/2011	5/12/2014	11/18/2011	2/7/2012	11/18/2011
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	300 U	300 U	300 U	- -	300 U	- -	300 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	73 J	50 U	2300	- -	440	- -	330
ANIONS	14808-79-8	Sulfate	µg/L	--	--	13200	13100	11100	- -	19700	- -	11100
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 J	0.24	0.6	0.48	2.1	0.19 U	0.12 J
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	0.19 U	0.19 U	0.19 U	0.22	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.19 U	0.18 J	0.33	0.44	0.82	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.19 U	0.42	0.41	1.1	0.92	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.2 U	0.19 U	0.19 U	0.19 U	0.57 U	0.19 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.2 U	0.19 U	0.19 U	0.19 U	0.38 U	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	3.4	2.8	13.1	12.9	22.3	5.2	6.6
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*5.4*	*5*	*19.1*	*18.7*	*64.5*	2	*3*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	395 J	715 J	35 U	- -	35 U	- -	35 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	*5160 J*	*5240 J*	164	- -	19	- -	32.2
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-029	L1-TTTW-030		L1-TTTW-031		L1-TTTW-032	
					Sample ID	L1-TTTW-029-11182011	L1-TTTW-030-11192011	L1-TTTW-030-11212011	L1-TTTW-031-11182011	L1-TTTW-031-5002014	L1-TTTW-032-11162011	L1-TTTW-032-11182011
					Sample Depth (ft)	13 - 23	10 - 20	10 - 20	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	11/18/2011	11/19/2011	11/21/2011	11/18/2011	5/6/2014	11/16/2011	11/18/2011
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	--	--	--	--	--	--	--
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	--	--	--	--	--	--	--
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	--	--	--	--	--	--	--
GENERAL	14265-44-2	Phosphate	µg/L	--	--	--	--	--	--	--	--	--
GENERAL	18496-25-8	Sulfide	µg/L	--	--	2500	300 U	--	300 U	--	--	300 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	--	--	--	--	--	--	--
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	--	--	--	--	--	--	--
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	--	--	--	--	--	--	--
GENERAL	TSS	Total suspended solids	µg/L	--	--	--	--	--	--	--	--	--
ANIONS	16887-00-6	Chloride	µg/L	--	--	--	--	--	--	--	--	--
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	--	--	--	--	--	--	--
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	210	50 U	--	50 U	--	50 U	--
ANIONS	14808-79-8	Sulfate	µg/L	--	--	184000	56000	--	21500	--	18800	--
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.19 U	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	0.19 U	--	1.3	0.84	0.19 U	--
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.19 U	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	--	--	--	--	--	--	--
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.19 U	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	--	--	--	--	--	--	--
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.19 U	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	1.5	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	--	--	--	--	--	--	--
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.19 U	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	1.9	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	--	--	--	--	--	--	--
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.19 U	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	0.76 U	--	0.17 J	0.19 U	0.19 U	--
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	0.19 U	--	0.2 U	0.19 U	0.19 U	--
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	9.6	--	1.3	1.1	0.19 U	--
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	--	--	--	--	--	--	--
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	0.35	--	*55.5*	*43.9*	0.19 U	--
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	--	--	--	--	--	--	--
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.19 U	--	0.2 U	0.19 U	0.19 U	--
METALS	7429-90-5	Aluminum	µg/L	20000	11272	--	--	--	--	--	--	--
METALS	7440-38-2	Arsenic	µg/L	10	33.3	--	--	--	--	--	--	--
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	--	--	--	--	--	--	--
METALS	7440-39-3	Barium	µg/L	2000	430	--	--	--	--	--	--	--
METALS	7440-43-9	Cadmium	µg/L	5	5	--	--	--	--	--	--	--
METALS	7440-70-2	Calcium	µg/L	--	119033	--	--	--	--	--	--	--
METALS	7440-47-3	Chromium	µg/L	100	31	--	--	--	--	--	--	--
METALS	7439-89-6	Iron	µg/L	14000	9736	--	--	--	--	--	--	--
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	35 U	--	35 U	35 U	--	--	63.4 J
METALS	7439-92-1	Lead	µg/L	15	18.05	--	--	--	--	--	--	--
METALS	7439-95-4	Magnesium	µg/L	--	45243	--	--	--	--	--	--	--
METALS	7439-96-5	Manganese	µg/L	430	579.7	--	--	--	--	--	--	--
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	40.9	--	206	359 J	--	--	*888*
METALS	7439-97-6	Mercury	µg/L	2	1	--	--	--	--	--	--	--
METALS	7782-49-2	Selenium	µg/L	50	10	--	--	--	--	--	--	--
METALS	7440-22-4	Silver	µg/L	130	10	--	--	--	--	--	--	--
METALS	7440-23-5	Sodium	µg/L	--	42581	--	--	--	--	--	--	--
METALS	7440-66-6	Zinc	µg/L	6000	789	--	--	--	--	--	--	--
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	--	--	--	--	--	--	--
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	--	--	--	--	--	--	--
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	--	--	--	--	--	--	--
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	--	--	--	--	--	--	--
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	--	--	--	--	--	--	--
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	--	--	--	--	--	--	--
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	--	--	--	--	--	--	--
VOLATILES	67-64-1	Acetone	µg/L	18000	--	--	--	--	--	--	--	--
VOLATILES	67-66-3	Chloroform	µg/L	80	--	--	--	--	--	--	--	--
VOLATILES	74828	Methane	µg/L	--	--	--	--	--	--	--	--	--
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	--	--	--	--	--	--	--
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	--	--	--	--	--	--	--

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-034	L1-TTTW-035		L1-TTTW-036			
					Sample ID	L1-TTTW-034-12152011	L1-TTTW-035-12152011	L1-TTTW-035-5002014	L1-TTTW-036-10232012	L1-TTTW-036-10232012-FD	L1-TTTW-036A-10252012	L1-TTTW-036A-10252012-FD
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	12/15/2011	12/15/2011	5/11/2014	10/23/2012	10/23/2012	10/25/2012	10/25/2012
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[(1)])							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	300 U	300 U	- -	1200	670	- -	- -
GENERAL	TDS	Total dissolved solids	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	6000	620	- -	33 U	33 U	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	25500	21800	- -	- -	- -	12600	12700
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.19 U	7.5	18.6	0.2 U	0.19 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.19 U	2.2 J	1.9	0.2 U	0.19 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.19 U	*9.5*	*8.3*	0.2 U	0.19 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	μg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.19 U	*0.57*	*0.4*	0.2 U	0.19 U	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	μg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.19 U	*3.7*	*4.2*	0.2 U	0.19 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.19 U	*5.8*	*4.5*	0.2 U	0.19 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	- -	- -
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.19 U	0.76 U	0.19 U	0.2 U	0.19 U	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.19 U	0.35	0.44	0.2 U	0.19 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.19 U	40.6	59.8	0.2 U	0.19 U	- -	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.19 U	*117*	*144*	0.2 U	0.19 U	- -	- -
EXPLOSIVES	121-82-4	RDX, dissolved	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	- -	- -
METALS	7429-90-5	Aluminum	μg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	μg/L	10	--	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	μg/L	14000	--	430	113 J	- -	29 U	29 U	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	μg/L	430	--	188	49.1	- -	*1160*	*1190*	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	μg/L	18000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	μg/L	80	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1
Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	L1-TTTW-037	L1-TTTW-038	L1-TTTW-039			L1-TTTW-040	
					Sample ID	L1-TTTW-037-10282012	L1-TTTW-038-10232012	L1-TTTW-039A-10252012	L1-TTTW-039-10282012	L1-TTTW-039-5002014	L1-TTTW-040-10242012	L1-TTTW-040-5002014
					Sample Depth (ft)	12.5 - 22.5	13 - 23	12.5 - 22.5	12.5 - 22.5	12.5 - 22.5	12.5 - 22.5	12.5 - 22.5
					Sample Date	10/26/2012	10/23/2012	10/25/2012	10/26/2012	5/11/2014	10/24/2012	5/8/2014
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	970	1100	- -	500 B	- -	2000	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	130	210	- -	1200	- -	510	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	19800	41200	- -	30200	- -	26600	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.33	4.1
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	0.19 U	1.5	- -	1.1	2.2	1.9
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.42	0.19 U	*3.1*	- -	1.8	0.19 U	0.24
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.19 U	0.19 U	- -	0.12 J	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.43	0.19 U	*3.8*	- -	1.8	0.25	0.16 J
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.38 U	0.19 U	0.76 U	- -	0.19 U	0.19 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	0.19 U	0.19 U	- -	0.19	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.7 U	0.19 U	63.8	- -	43.9	24.4	28.1
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*4.3*	0.19 U	*100*	- -	*67.5*	*749*	*720*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	41.5 B	29 U	29 U	- -	- -	29 U	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	31.9	6.4 B	103	- -	- -	392	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	L1-TTTW-041	L1-TTTW-042	L1-TTTW-043	L1-TTTW-044	L1-TTTW-045	L1-TTTW-046
					Sample ID	L1-TTTW-041-10242012	L1-TTTW-042-11192012	L1-TTTW-043-11182012	L1-TTTW-044-11182012	L1-TTTW-045-11192012	L1-TTTW-046-1242012
					Sample Depth (ft)	13 - 23	12.5 - 22.5	12.5 - 22.5	12.5 - 22.5	13 - 23	13 - 23
					Sample Date	10/24/2012	11/19/2012	11/18/2012	11/18/2012	11/19/2012	12/4/2012
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	710	190 U	220 U	250 B	190 U	700 B
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	490	33 U	78 B	33 U	33 U	1600
ANIONS	14808-79-8	Sulfate	µg/L	--	--	22200	28500	21400	28600	18400	25100
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.2 U	0.19 U	0.39	0.19 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.4	0.2 U	0.28	0.19 J	0.19 U	0.29
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.2 U	0.19 U	0.31	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.2 U	0.35	0.71	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.89	0.2 U	0.43	0.54	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.57 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	13	0.2 U	3.2	5	0.19 U	1.9
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*83.5*	0.2 U	*7.2*	*4.6*	0.19 U	*9.7*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.2 U	0.38 U	0.2 U	0.19 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	29 U	29 U	29 U	56 B	29 U	29.4 B
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	341	95.8	297	157	*608*	12.1 B
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1
Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	L1-TTTW-047		L1-TTTW-048	L1-TTTW-049		L1-TTTW-050
					Sample ID	L1-TTTW-047-1242012	L1-TTTW-047-5002014	L1-TTTW-048-11182012	L1-TTTW-049-10282012	L1-TTTW-049A-10292012	L1-TTTW-050A-10252012
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	12.5 - 22.5
					Sample Date	12/4/2012	5/13/2014	11/18/2012	10/26/2012	10/29/2012	10/25/2012
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	200 U	- -	200 U	190 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	900	- -	33 U	39 B	- -	33 B
ANIONS	14808-79-8	Sulfate	µg/L	--	--	12000	- -	4800	- -	29800	34800
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.7	0.63	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.85	0.3	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.64	0.38 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.57 U	0.19 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.41	0.19 U	0.19 U	0.19 U	- -	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	23.1	12.4	1.8	0.19 U	- -	0.19 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*40*	*18.6*	1.5	0.49	- -	0.19 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.29	0.19 U	0.19 U	0.19 U	- -	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	29 U	- -	29.7 B	29 U	- -	29 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	47	- -	*674*	307	- -	*499*
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-051		L1-TTTW-052	L1-TTTW-053	L1-TTTW-054	L1-TTTW-056	
					Sample ID	L1-TTTW-051-11142012	L1-TTTW-051-11142012A	L1-TTTW-052-11182012	L1-TTTW-053-11152012	L1-TTTW-054-11122012	L1-TTTW-056-11202012	L1-TTTW-056-5002014
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	8 - 18	21.5 - 26.5	21.5 - 26.5
					Sample Date	11/14/2012	11/14/2012	11/18/2012	11/15/2012	11/12/2012	11/20/2012	5/19/2014
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	200 U	220 U	220 U	420 B	690 B	- -
GENERAL	TDS	Total dissolved solids	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	33 U	- -	300	33 U	46 B	95 B	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	- -	13600	16100	9500	10600	21600	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.2 U	- -	0.19 U	0.2 U	0.38 U	17.2	26
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	μg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	μg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	0.57
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	*0.77*
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	*2.4*
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	10.4	15
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	9.8	8.3
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.2 U	- -	0.19 U	0.2 U	2.9	11.8	42.6
EXPLOSIVES	2691-41-0	HMX, dissolved	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.2 U	- -	0.19 U	0.2 U	*4.9*	*498*	*1280*
EXPLOSIVES	121-82-4	RDX, dissolved	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	- -	0.19 U	0.2 U	0.19 U	3.8 U	0.19 U
METALS	7429-90-5	Aluminum	μg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	μg/L	10	--	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	μg/L	14000	--	37.1 B	- -	29 U	48.2 B	83.9 B	29 U	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	μg/L	430	--	209	- -	253	307	4.2 B	*624*	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	μg/L	18000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	μg/L	80	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-057	L1-TTTW-058		L1-TTTW-059	L1-TTTW-060	L1-TTTW-062	
					Sample ID	L1-TTTW-057-11182012	L1-TTTW-058-11152012	L1-TTTW-058-5002014	L1-TTTW-059-3182013	L1-TTTW-060-3172013	L1-TTTW-062-3182013	L1-TTTW-062-5002014
					Sample Depth (ft)	12.5 - 22.5	12.5 - 22.5	12.5 - 22.5	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	11/18/2012	11/15/2012	5/12/2014	3/18/2013	3/17/2013	3/18/2013	5/6/2014
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	300 B	200 U	- -	230 U	220 U	230 B	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	160	160	- -	69 B	400	290	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	35100	12100	- -	21100	26600	31800	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	3.9 U	0.19 U	0.19 U	0.19 U	333	333
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.3	13.3	11.6	0.19 U	0.19 U	34.6	19.4
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	3.9 U	0.19 U	0.19 U	0.19 U	0.14 J	0.2 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	3.9 U	0.19 U	0.19 U	0.19 U	0.079 J	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	3.9 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	3.9 U	*3.8*	0.19 U	0.19 U	*16.3*	*15.8*
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	3.9 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	3.9 U	1.6	0.19 U	0.19 U	*9.6*	*8.6*
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	3.9 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.34	2.9 J	1.3	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.28	5.2	3.1	0.19 U	0.19 U	7.2	3.3
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.32	57.8	52.7	0.19 U	1.4	332	272
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*17.2*	*378*	*360*	0.19 U	0.38 U	*914*	*827*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	3.9 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	35.6 B	29 U	- -	29 U	29 U	117 B	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	126	84	- -	310	*793*	47.3	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-063		L1-TTTW-064	L1-TTTW-065		L1-TTTW-066	L1-TTTW-067
					Sample ID	L1-TTTW-063-3182013	L1-TTTW-063-5002014	L1-TTTW-064-3182013	L1-TTTW-065-3172013	L1-TTTW-065-3172013-FD	L1-TTTW-066-5002014	L1-TTTW-067-5002014
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	3/18/2013	5/11/2014	3/18/2013	3/17/2013	3/17/2013	5/8/2014	5/12/2014
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	240 U	- -	420 B	220 U	220 U	240 B	220 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	82	- -	160	240	260	320	2100
ANIONS	14808-79-8	Sulfate	µg/L	--	--	33700	- -	39700	19100	19200	43700	46800
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	2	1.5	0.63	0.2	0.21	2.4	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	1.4	0.92	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.52	0.31	0.19 U	0.19 U	0.19 U	0.45	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.5	4.2	1.1	2.5	2.3	20.6	0.19 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*151*	*179*	*22.6*	*6.3*	*6.3*	*40.8*	0.19 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	29 U	- -	29 U	29 U	29 U	189 B	17 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	*504*	- -	237	337	340	272	43.1
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.1-5. Detected Chemicals in Groundwater—Line 1

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-068	L1-TTTW-069	L1-TTTW-070	L1-TTTW-071	L1-TTTW-072
					Sample ID	L1-TTTW-068-5002014	L1-TTTW-069-5002014	L1-TTTW-070-5002014	L1-TTTW-071-5002014	L1-TTTW-072-5002014
					Sample Depth (ft)	13 - 23	13 - 23	13 - 23	13 - 23	13 - 23
					Sample Date	5/13/2014	5/12/2014	5/14/2014	5/12/2014	5/9/2014
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])					
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	310 B	220 U	310 B	2100	230 B
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	1100	160	1200	1100	260
ANIONS	14808-79-8	Sulfate	µg/L	--	--	37400	9900	32400	54800	30100
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	0.19 U	0.19 U	0.19 U	0.65
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	0.19 U	1.7	0.19 U	2.2
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	0.19 U	0.96	0.19 U	*22*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	17 U	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	17 U	17 U	17 U	34.2 B
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	274	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	146	201	*544*	60.3
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -

Notes:

DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

RDX = 1,3,5-trinitro-1,3,5-triazine

TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol

B = The analyte was detected in the associated method and/or calibration blank.

D = Diluted sample.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

M = Manual integrated compound

P = Sample failed confirmation precision criteria.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

-- = Not analyzed

µg/L = Micrograms per Liter

pCi/L =picocuries per liter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)

[(1)] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) or sample sizes less than 59 have a coverage probability less than 95%.

Table 5.1-6. Groundwater Quality Parameters—Line 1

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (uS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
L1-MW102	11/14/2018	5.73	7.59	14.3	456	-72.3	1.43	94.2
L1-MW103	3/25/2019	Frozen	6.92	11.1	870	17.7	0.8	3.46
L1-MW104	11/14/2018	6.08	7.39	12.4	620	-65.6	1.96	52.5
L1-MW105	11/14/2018	4.78	7.48	12.7	530	-52.6	1.51	30.1
L1-MW106	11/14/2018	3.37	7.39	13.5	610	165.5	3.44	18.5
L1-MW107	11/16/2018	9.33	7.44	15.3	700	179.3	2.2	42.3
JAW-40	11/15/2018	4.04	7.31	13.6	6	183.1	3.67	7.31
JAW-41	11/15/2018	7.04	7.6	11.7	267	91.8	2.72	14.5
JAW-42	11/15/2018	5.06	7.03	12.9	188	112.3	1.87	2.39
JAW-47	11/15/2018	5.69	6.96	13.1	290	105.6	0.6	7.57
JAW-52	11/14/2018	7.64	7.18	14.1	603	193.2	4.45	5.94
L1-TTMW-100	11/15/2018	4.96	7.5	12.7	590	-135.5	1.87	6.91
L1-TTMW-101	11/15/2018	5.3	6.61	12.8	640	6.4	3.04	6.55

Notes:

Water quality parameters were measured in the field using a YSI multi-meter.

°C = degrees Celsius

DO = dissolved oxygen

mV = millivolt(s)

NTU = nephelometric turbidity unit

ORP = oxidation-reduction potential

ug/L = microgram(s) per liter

uS/cm = microsiemen(s) per centimeter

ft = feet

btoc = below top of casing

Table 5.1-7. Data Groupings Used in the HHRA - Line 1

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Description[1]	Sample Count
AOC_GW-All	Groundwater for all of Line 1	127
AOC_GW-CW	Shallow Groundwater in trench/culvert (DTW ≤ 10 ft bgs)	27
AOC_GW_NP Core	Groundwater samples collected from "North Plume"	32
AOC_GW_SP Core	Groundwater samples collected from "South Plume"	24
AOC_GW_SP#1	Groundwater samples collected from "Small Plume #1"	10
AOC_GW_SP#2	Groundwater samples collected from "Small Plume #2"	3
AOC_GW_SP#3	Groundwater samples collected from "Small Plume #3"	1
AOC_GW_SP#4	Groundwater samples collected from "Small Plume #4"	1

Note:

[1] Data sets for the plumes were not used for COPC screening but were used to calculate EPCs.

bgs - below ground surface

COPC - chemical of potential concern

DTW - depth to water

EPC - exposure point concentration

ft - feet

Table 5.1-8. Samples Used in the HHRA - Line 1

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-024	L1-TTTW-024-11162011	11/16/2011	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-024	L1-TTTW-024-11162011-FD1	11/16/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-032	L1-TTTW-032-11162011	11/16/2011	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-017	L1-TTTW-017-11182011	11/18/2011	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-019	L1-TTTW-019-11182011	11/18/2011	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-020	L1-TTTW-020-11182011	11/18/2011	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-026	L1-TTTW-026-11182011	11/18/2011	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-028	L1-TTTW-028-11182011	11/18/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-029	L1-TTTW-029-11182011	11/18/2011	13	23
AOC_GW-ALL	AOC_GW_SP#2		WG	L1-TTTW-031	L1-TTTW-031-11182011	11/18/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-032	L1-TTTW-032-11182011	11/18/2011	13	23
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-021	L1-TTTW-021-11192011	11/19/2011	13	23
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-022	L1-TTTW-022-11192011	11/19/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-023	L1-TTTW-023-11192011	11/19/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-023	L1-TTTW-023-11192011-FD2	11/19/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-030	L1-TTTW-030-11192011	11/19/2011	10	20
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-021	L1-TTTW-021-11212011	11/21/2011	13	23
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-022	L1-TTTW-022-11212011	11/21/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-023	L1-TTTW-023-11212011	11/21/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-023	L1-TTTW-023-11212011-FD2	11/21/2011	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-025	L1-TTTW-025-11182011	11/21/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-030	L1-TTTW-030-11212011	11/21/2011	10	20
AOC_GW-ALL			WG	L1-TTTW-034	L1-TTTW-034-12152011	12/15/2011	13	23
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-035	L1-TTTW-035-12152011	12/15/2011	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-018	L1-TTTW-018-02072012	2/7/2012	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-027	L1-TTTW-027-02072012	2/7/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-036	L1-TTTW-036-10232012	10/23/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-036	L1-TTTW-036-10232012-FD	10/23/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-038	L1-TTTW-038-10232012	10/23/2012	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-040	L1-TTTW-040-10242012	10/24/2012	12.5	22.5
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-041	L1-TTTW-041-10242012	10/24/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-036	L1-TTTW-036A-10252012	10/25/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-036	L1-TTTW-036A-10252012-FD	10/25/2012	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-039	L1-TTTW-039A-10252012	10/25/2012	12.5	22.5
AOC_GW-ALL			WG	L1-TTTW-050	L1-TTTW-050A-10252012	10/25/2012	12.5	22.5
AOC_GW-ALL	AOC_GW_SP#2		WG	L1-TTTW-037	L1-TTTW-037-10282012	10/26/2012	12.5	22.5

Table 5.1-8. Samples Used in the HHRA - Line 1

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-039	L1-TTTW-039-10282012	10/26/2012	12.5	22.5
AOC_GW-ALL			WG	L1-TTTW-049	L1-TTTW-049-10282012	10/26/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-049	L1-TTTW-049A-10292012	10/29/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-051	L1-TTTW-051-11142012	11/14/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-051	L1-TTTW-051-11142012A	11/14/2012	13	23
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-043	L1-TTTW-043-11182012	11/18/2012	12.5	22.5
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-044	L1-TTTW-044-11182012	11/18/2012	12.5	22.5
AOC_GW-ALL			WG	L1-TTTW-048	L1-TTTW-048-11182012	11/18/2012	13	23
AOC_GW-ALL			WG	L1-TTTW-042	L1-TTTW-042-11192012	11/19/2012	12.5	22.5
AOC_GW-ALL			WG	L1-TTTW-045	L1-TTTW-045-11192012	11/19/2012	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-046	L1-TTTW-046-1242012	12/4/2012	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-047	L1-TTTW-047-1242012	12/4/2012	13	23
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-065	L1-TTTW-065-3172013	3/17/2013	13	23
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-065	L1-TTTW-065-3172013-FD	3/17/2013	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-062	L1-TTTW-062-3182013	3/18/2013	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-063	L1-TTTW-063-3182013	3/18/2013	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-064	L1-TTTW-064-3182013	3/18/2013	13	23
AOC_GW-ALL		AOC_GW-CW	WG	JAW-38	JAW-38-5002014	5/6/2014	5	10
AOC_GW-ALL		AOC_GW-CW	WG	JAW-39	JAW-39-5002014	5/6/2014	7	12
AOC_GW-ALL		AOC_GW-CW	WG	JAW-39	JAW-39-5002014-FD	5/6/2014	7	12
AOC_GW-ALL		AOC_GW-CW	WG	JAW-52	JAW-52-5002014	5/6/2014	10	20
AOC_GW-ALL	AOC_GW_SP#2		WG	L1-TTTW-031	L1-TTTW-031-5002014	5/6/2014	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-062	L1-TTTW-062-5002014	5/6/2014	13	23
AOC_GW-ALL			WG	JAW-40	JAW-40-5002014	5/7/2014	10	20
AOC_GW-ALL		AOC_GW-CW	WG	JAW-41	JAW-41-5002014	5/7/2014	5	15
AOC_GW-ALL	AOC_GW_NP Core	AOC_GW-CW	WG	JAW-50	JAW-50-5002014	5/8/2014	12	22
AOC_GW-ALL		AOC_GW-CW	WG	JAW-51	JAW-51-5002014	5/8/2014	9	19
AOC_GW-ALL			WG	JAW-603	JAW-603-5002014	5/8/2014	87	97
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-040	L1-TTTW-040-5002014	5/8/2014	12.5	22.5
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-066	L1-TTTW-066-5002014	5/8/2014	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-072	L1-TTTW-072-5002014	5/9/2014	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-017	L1-TTTW-017-5002014	5/10/2014	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-017	L1-TTTW-017-5002014-FD	5/10/2014	13	23
AOC_GW-ALL	AOC_GW_SP#1		WG	L1-TTTW-035	L1-TTTW-035-5002014	5/11/2014	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-039	L1-TTTW-039-5002014	5/11/2014	12.5	22.5
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-063	L1-TTTW-063-5002014	5/11/2014	13	23

Table 5.1-8. Samples Used in the HHRA - Line 1

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-025	L1-TTTW-025-5002014	5/12/2014	13	23
AOC_GW-ALL			WG	L1-TTTW-067	L1-TTTW-067-5002014	5/12/2014	13	23
AOC_GW-ALL			WG	L1-TTTW-069	L1-TTTW-069-5002014	5/12/2014	13	23
AOC_GW-ALL			WG	L1-TTTW-071	L1-TTTW-071-5002014	5/12/2014	13	23
AOC_GW-ALL		AOC_GW-CW	WG	JAW-42	JAW-42-5002014	5/13/2014	5	10
AOC_GW-ALL	AOC_GW_NP Core		WG	L1-TTTW-047	L1-TTTW-047-5002014	5/13/2014	13	23
AOC_GW-ALL			WG	L1-TTTW-068	L1-TTTW-068-5002014	5/13/2014	13	23
AOC_GW-ALL	AOC_GW_NP Core	AOC_GW-CW	WG	L1-TTMW-101	L1-TTMW-101-5002014	5/14/2014	30	35
AOC_GW-ALL			WG	L1-TTTW-070	L1-TTTW-070-5002014	5/14/2014	13	23
AOC_GW-ALL	AOC_GW_NP Core		WG	JAW-602	JAW-602-5002014	5/15/2014	87.5	97.5
AOC_GW-ALL	AOC_GW_SP#1	AOC_GW-CW	WG	L1-MW1	L1-MW1-5002014	5/19/2014	25	35
AOC_GW-ALL		AOC_GW-CW	WG	JAW-52	JAW-52-1118	11/14/2018	10	20
AOC_GW-ALL		AOC_GW-CW	WG	L1-MW106	L1-MW106-1118	11/15/2018	10	20
AOC_GW-ALL		AOC_GW-CW	WG	L1-MW105	L1-MW-105-1118	11/15/2018	15	25
AOC_GW-ALL			WG	JAW-40	JAW-40-1118	11/15/2018	10	20
AOC_GW-ALL		AOC_GW-CW	WG	L1-MW104	L1-MW104-1118	11/15/2018	15	25
AOC_GW-ALL	AOC_GW_NP Core	AOC_GW-CW	WG	L1-TTMW-101	L1-TTMW-101-1118	11/15/2018	30	35
AOC_GW-ALL		AOC_GW-CW	WG	JAW-42	JAW42-1118	11/15/2018	5	10
AOC_GW-ALL		AOC_GW-CW	WG	JAW-41	JAW-41-1118	11/16/2018	5	15
AOC_GW-ALL		AOC_GW-CW	WG	L1-MW107	L1-MW107-1118	11/16/2018	15	25
AOC_GW-ALL	AOC_GW_SP Core		WG	IAAP132578	IAAP132615	12/7/2010	0	0
AOC_GW-ALL	AOC_GW_SP Core		WG	IAAP132590	IAAP132617	12/7/2010	0	0
AOC_GW-ALL	AOC_GW_SP Core		WG	IAAP132602	IAAP132619	12/7/2010	0	0
AOC_GW-ALL			WG	IAAP135624	IAAP135820	4/13/2011	0	0
AOC_GW-ALL			WG	IAAP135684	IAAP135821	4/13/2011	0	0
AOC_GW-ALL	AOC_GW_SP#3		WG	IAAP135732	IAAP135822	4/14/2011	0	0
AOC_GW-ALL	AOC_GW_NP Core		WG	IAAP135774	IAAP135823	4/14/2011	0	0
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-011	L1-TTTW-011-11192011	11/19/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-012	L1-TTTW-012-11192011	11/19/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-013	L1-TTTW-013-11192011	11/19/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-014	L1-TTTW-014-11192011	11/19/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-015	L1-TTTW-015-11192011	11/19/2011	12	22
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-016	L1-TTTW-016-11192011	11/19/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-011	L1-TTTW-011-11212011	11/21/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-012	L1-TTTW-012-11212011	11/21/2011	13	23
AOC_GW-ALL			WG	L1-TTTW-013	L1-TTTW-013-11212011	11/21/2011	13	23

Table 5.1-8. Samples Used in the HHRA - Line 1

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW-ALL			WG	L1-TTTW-014	L1-TTTW-014-11212011	11/21/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-015	L1-TTTW-015-11212011	11/21/2011	12	22
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-016	L1-TTTW-016-11212011	11/21/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-009	L1-TTTW-009-12152011	12/15/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-009	L1-TTTW-009-12152011-FD3	12/15/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-010	L1-TTTW-010-12152011	12/15/2011	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-054	L1-TTTW-054-11122012	11/12/2012	8	18
AOC_GW-ALL			WG	L1-TTTW-053	L1-TTTW-053-11152012	11/15/2012	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-058	L1-TTTW-058-11152012	11/15/2012	12.5	22.5
AOC_GW-ALL			WG	L1-TTTW-052	L1-TTTW-052-11182012	11/18/2012	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-057	L1-TTTW-057-11182012	11/18/2012	12.5	22.5
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-056	L1-TTTW-056-11202012	11/20/2012	21.5	26.5
AOC_GW-ALL			WG	L1-TTTW-060	L1-TTTW-060-3172013	3/17/2013	13	23
AOC_GW-ALL			WG	L1-TTTW-059	L1-TTTW-059-3182013	3/18/2013	13	23
AOC_GW-ALL		AOC_GW-CW	WG	JAW-44	JAW-44-5002014	5/9/2014	5	10
AOC_GW-ALL		AOC_GW-CW	WG	JAW-45	JAW-45-5002014	5/9/2014	8	13
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-009	L1-TTTW-009-5002014	5/10/2014	13	23
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-016	L1-TTTW-016-5002014	5/11/2014	13	23
AOC_GW-ALL		AOC_GW-CW	WG	JAW-46	JAW-46-5002014	5/12/2014	5	10
AOC_GW-ALL		AOC_GW-CW	WG	JAW-46	JAW-46-5002014-FD	5/12/2014	5	10
AOC_GW-ALL		AOC_GW-CW	WG	JAW-48	JAW-48-5002014	5/12/2014	30	44
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-058	L1-TTTW-058-5002014	5/12/2014	12.5	22.5
AOC_GW-ALL		AOC_GW-CW	WG	JAW-47	JAW-47-5002014	5/13/2014	13	18
AOC_GW-ALL	AOC_GW_SP Core	AOC_GW-CW	WG	L1-TTMW-100	L1-TTMW-100-5002014	5/19/2014	32	37
AOC_GW-ALL	AOC_GW_SP Core		WG	L1-TTTW-056	L1-TTTW-056-5002014	5/19/2014	21.5	26.5
AOC_GW-ALL		AOC_GW-CW	WG	JAW-47	JAW-47-1118	11/15/2018	13	18
AOC_GW-ALL		AOC_GW-CW	WG	L1-MW102	L1-MW102-1118	11/15/2018	15	25
AOC_GW-ALL	AOC_GW_SP Core	AOC_GW-CW	WG	L1-TTMW-100	L1-TTMW-100-1118	11/15/2018	32	37
AOC_GW-ALL	AOC_GW_SP Core	AOC_GW-CW	WG	L1-MW103	L1-MW103-0319	3/25/2019	20	30
AOC_GW-ALL	AOC_GW_SP#4		WG	IA92-12	L1-MW-UNK1-11182012	11/18/2012	7.5	10

Notes:

(1) The data were reduced such that when a normal and duplicate sample were available, the highest detected concentration among normal or duplicate samples was used when a chemical was detected in any sample. If both results were non-detect, the lowest reported detection limit (i.e., reporting limit) was used.

WG = groundwater

Table 5.2-2. Gauging Information—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval (ft btoc)	Depth to Water (ft btoc)	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)
G-14	11/13/2018	26-36	1.06	678.59	677.53
GZ-1	11/13/2018	40-50	6.76	685.74	678.98
GZ-2	11/13/2018	20-30	0.14	673.61	673.47
GZ-2A	11/13/2018	NA	5.27	671.47	666.2
GZ-3	11/13/2018	36-46	2.3	680.76	678.46
JAW-43	11/13/2018	12-17	4.08	697.02	692.94
JAW-44	11/13/2018	5-10	5.55	698.67	693.12
JAW-601	11/16/2018	57-67	5.42	681.406	675.986
SL-81R	11/16/2018	5.5-10.5	9.1	681.12	672.02

Notes:

ft = feet

btoc = below top of casing

amsl = above mean sea level

NA = Not Available

Table 5.2-3. Detected Chemicals in Groundwater—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-14					GZ-1					
					Sample ID	F05-G-14-GW-REG	S06-G-14-GW-REG	F06-G-14-GW-REG	G-14-5002014	G-14-1118	GZ-1-1	GZ-1-BL	GZ-1-5	GZ-1-2	GZ-1-5002014	GZ-1-5002014-FD
					Sample Depth (ft)	26 - 36	26 - 36	26 - 36	26 - 36	26 - 36	40 - 50	40 - 50	40 - 50	40 - 50	40 - 50	40 - 50
					Sample Date	10/6/2005	4/13/2006	9/6/2006	5/19/2014	11/15/2018	6/29/2006	7/13/2006	7/28/2006	6/27/2007	5/14/2014	5/14/2014
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[(1)])											
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	373000	420000	395000	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	414000	410000	603000	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	220 U	- -	- -	- -	- -	- -	1400	1400
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	354000	349000	462000	533000	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	3000	3200	2900	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	4000 U	9000 B	4000 U	20000	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	1000 U	6100 J	6900	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	50 U	50 U	50 U	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	33 U	- -	- -	- -	- -	- -	33 U	33 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	1000 U	1000 U	1000 U	600 U	- -	- -	- -	- -	- -	600 U	600 U
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	- -	- -	- -	- -	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	0.21 U	0.19 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	0.21 U	0.19 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	0.21 U	0.19 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.2 U	0.19 U	0.19 U	0.2 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	0.21 U	0.19 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.2 U	0.19 U	0.19 U	0.2 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.2 U	0.2 U	0.19 U	0.19 U	0.2 UJ	- -	- -	- -	- -	0.19 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	- -	- -	- -	- -	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.14 J	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	0.21 U	0.19 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.13 J	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	0.21 U	0.19 U	0.2 U	0.2 U	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	0.2 U	0.19 U	0.19 U	0.1 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	- -	69 B	- -	- -	- -	- -	- -	165 B	144 B
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	- -	67.7	- -	- -	- -	- -	- -	66.8	64.3
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	4330	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.2-3. Detected Chemicals in Groundwater—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])													
					Location	GZ-2							GZ-2A					
					Sample ID	F04-GW-070	GZ-2-1	GZ-2-BL	GZ-2-5	GZ-2-2	GZ-2-5002014	GZ-2-1118	F04-GW-071	GZ-2A-1	GZ-2A-BL	GZ-2A-5	S07-GZ-2A-GW-REG	GZ-2A-2
					Sample Depth (ft)	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	5 - 10	5 - 10	5 - 10	5 - 10	5 - 10	5 - 10
					Sample Date	11/18/2004	6/29/2006	7/13/2006	7/28/2006	6/28/2007	5/19/2014	11/16/2018	11/18/2004	6/29/2006	7/13/2006	7/29/2006	6/5/2007	6/29/2007
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	370000	- -	- -	- -	- -	- -	- -	470000	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	4100	- -	- -	- -	- -	- -	- -	3500	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	1000 U	- -	- -	- -	- -	- -	- -	1000 U	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	220 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	μg/L	--	--	- -	375000	371000	288000	374000	- -	- -	- -	408000	195000	286000	- -	717000
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	3100	- -	- -	- -	- -	- -	- -	8000	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	μg/L	--	--	- -	4000 U	5000 B	5000 B	657000	- -	- -	- -	53000	15000	6000 B	- -	84000
ANIONS	16887-00-6	Chloride	μg/L	--	--	1000 U	- -	- -	- -	- -	- -	- -	12000	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	200 U	- -	- -	- -	- -	- -	- -	200 U	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	33 U	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	1000 U	- -	- -	- -	- -	600 U	- -	80000	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	2.2	0.22 U	0.23 U	0.2 U	- -	1.9 U
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.49 U	- -	- -	- -	- -	0.19 U	0.1 UJ	120 D	- -	- -	- -	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	*73 D*	0.22 U	0.23 U	0.2 U	- -	*12.1*
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	μg/L	2.5	--	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	0.2 U	0.2 U	0.2 U	- -	*29.9*
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	*0.34 J*	0.22 U	0.23 U	0.2 U	- -	1.9 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	μg/L	0.24	--	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	0.2 U	0.2 U	0.2 U	- -	0.24 J
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	*0.28 J*	0.22 U	0.23 U	0.2 U	- -	1.9 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	*56 D*	0.22 U	0.23 U	0.2 U	- -	*38.5*
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	0.2 U	0.2 U	0.2 U	- -	*43.3*
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 UJ	0.48 U	0.22 U	0.23 U	0.2 U	- -	1.9 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	*61 D*	0.22 U	0.23 U	0.2 U	- -	*46.8*
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	0.2 U	0.2 U	0.2 U	- -	*54.5*
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 UJ	0.48 U	0.22 U	0.23 U	0.2 U	- -	1.9 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.49 U	- -	- -	- -	- -	0.19 U	0.2 UJ	14	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.49 U	- -	- -	- -	- -	0.19 U	0.1 UJ	23 P	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	*1100 D*	3	1.7	1.9	- -	747
EXPLOSIVES	2691-41-0	HMX, dissolved	μg/L	1000	--	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	4	6	2.2	- -	253
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	*14000 D*	*6.8*	*2.6*	*2.9*	*22.9*	*2860*
EXPLOSIVES	121-82-4	RDX, dissolved	μg/L	2	--	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	*10.2*	*10.6*	*3*	- -	*888*
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.49 U	0.21 U	0.19 U	0.2 U	0.2 U	0.19 U	0.1 UJ	0.48 U	0.22 U	0.23 U	0.2 U	- -	1.9 U
METALS	7429-90-5	Aluminum	μg/L	20000	11272	904	- -	- -	- -	- -	- -	- -	33.4 B	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	8.1 B	- -	- -	- -	- -	- -	- -	5.5 B	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	μg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	534	- -	- -	- -	- -	- -	- -	914	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	0.51 B	- -	- -	- -	- -	- -	- -	0.75 B	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	63500	- -	- -	- -	- -	- -	- -	136000	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	2.3 B	- -	- -	- -	- -	- -	- -	1.3 B	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	3170	- -	- -	- -	- -	- -	- -	5280	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	μg/L	14000	--	- -	- -	- -	- -	- -	77.5 B	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	2.6 B	- -	- -	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	30900	- -	- -	- -	- -	- -	- -	38900	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	122	- -	- -	- -	- -	- -	- -	*3660*	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	μg/L	430	--	- -	- -	- -	- -	- -	32.9	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	0.2 U	- -	- -	- -	- -	- -	- -	0.2 U	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	2.1 B	- -	- -	- -	- -	- -	- -	2.4 B	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	10 U	- -	- -	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	34400 E	- -	- -	- -	- -	- -	- -	14100 E	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	10.2 B	- -	- -	- -	- -	- -	- -	45.1	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	μg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	μg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	100	- -	- -	- -	- -	- -	- -	110	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.2-3. Detected Chemicals in Groundwater—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

					Location	GZ-2A			GZ-3						JAW-43	
					Sample ID	S08-GZ-2A-GW-REG	GZ-2A-5002014	GZ-2A-1118	GZ-3-1	GZ-3-BL	GZ-3-5	GZ-3-2	GZ-3-5002014	GZ-3-1118	JAW-43-050700	JAW-43-20001119
					Sample Depth (ft)	5 - 10	5 - 10	5 - 10	36 - 46	36 - 46	36 - 46	36 - 46	36 - 46	36 - 46	12 - 17	12 - 17
					Sample Date	5/7/2008	5/15/2014	11/16/2018	6/29/2006	7/13/2006	7/28/2006	6/27/2007	5/19/2014	11/15/2018	5/7/2000	11/19/2000
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95(1))											
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	280000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	20
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	45000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	220 U	- -	- -	- -	- -	- -	1300	- -	- -	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	447000	318000	378000	474000	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	300
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1800
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	4000 U	12000	4000 U	5000 B	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3700
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	4600	- -	- -	- -	- -	- -	33 U	- -	- -	140
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	48800	- -	- -	- -	- -	- -	600 U	- -	- -	12000
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	0.19 U	0.1 UJ	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.16 U	0.55 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	59.8	110 J	- -	- -	- -	- -	0.19 U	0.1 UJ	- -	0.55 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	1.5	0.1 UJ	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.16 U	0.55 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	0.19 U	0.1 UJ	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.16 U	0.55 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	- -	0.19 U	0.1 UJ	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.31 U	0.55 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	*4.3*	*2.9 J*	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.31 U	0.55 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	- -	0.19 U	0.2 UJ	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 UJ	0.31 U	0.55 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	*7.4*	*5.4 J*	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.31 U	0.55 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	- -	0.19 U	0.2 UJ	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 UJ	0.78 U	0.55 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	13.3	59 J	- -	- -	- -	- -	0.19 U	0.2 UJ	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	9.8	21 J	- -	- -	- -	- -	0.19 U	0.1 UJ	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	170	600 J	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.39 U	0.55 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	*4170*	*2380*	*3200 J*	0.2 U	0.19 U	0.19 U	0.19	0.19 U	0.1 UJ	0.16 U	0.51 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	0.2 U	0.2 U	0.2 U	0.42	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	- -	0.19 U	0.1 UJ	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 UJ	0.31 U	0.55 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.4 U	10 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	85.9	115 J
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.4 U	0.3 J
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	59500
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.8 U	10 U
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	384	- -	- -	- -	- -	- -	58.3 B	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.7 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	20700
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	*2810*	- -	- -	- -	- -	- -	80	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.1 U	0.21 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.6 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.8 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	30000
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.2-3. Detected Chemicals in Groundwater—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-43				JAW-44		JAW-601	
					Sample ID	JAW-43-20010604	JAW-43-20020616	JAW-43-20030602	JAW-43-5002014	F04-GW-069	JAW-44-5002014	JAW-601-050700	JAW-601-20001130
					Sample Depth (ft)	12 - 17	12 - 17	12 - 17	12 - 17	5 - 10	5 - 10	57 - 67	57 - 67
					Sample Date	6/4/2001	6/16/2002	6/2/2003	5/9/2014	11/18/2004	5/9/2014	5/7/2000	11/30/2000
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[(1)])								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	310000	300000	300000	- -	150000	- -	- -	460000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	40	30	120	- -	- -	- -	- -	1400
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	30000	130000	23000	- -	5200	- -	- -	65000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	- -	1000 U	- -	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	220 U	- -	220 U	- -	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	400	500	- -	- -	- -	- -	2100
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1500	1500	1300	- -	1100	- -	- -	3000
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	3000	4000	4000	- -	7000	- -	- -	1500
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	200	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	30	20	60	87 B	- -	2400	- -	30 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	12000	12000	14000	10100	32000	23300	- -	1000 U
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.16 U	0.16 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.4 U	0.58 U	1.4 U	0.19 U	0.5 U	0.19 U	- -	0.16 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.16 U	0.16 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.16 U	0.16 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.31 U	0.16 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.31 U	0.16 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.31 U	0.16 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.31 U	0.16 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.78 U	0.16 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	0.19 U	0.5 U	0.19 U	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	0.19 U	0.5 U	0.19 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.1 U	0.47 U	1.4 U	0.19 U	0.2 J	1.1	0.39 U	0.16 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.16 U	0.15 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.1 U	0.47 U	1.4 U	0.19 U	0.5 U	0.19 U	0.31 U	0.16 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	152 B	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	10 U	2.9 J	- -	20 U	- -	2.4 U	10 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	139 J	120 J	124 J	- -	123 B	- -	558	639
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	5 U	5 U	- -	0.56 B	- -	0.4 U	0.6 J
METALS	7440-70-2	Calcium	µg/L	--	119033	62500	- -	- -	- -	38000	- -	- -	85600
METALS	7440-47-3	Chromium	µg/L	100	31	0.3 J	10 U	10 U	- -	0.8 B	- -	1.8 U	0.4 J
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	105	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	- -	17 U	- -	26.2 B	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	10 U	10 U	- -	10 U	- -	1.7 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	23300	- -	- -	- -	15300	- -	- -	33200
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	40.2	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	- -	*758*	- -	3 B	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	0.2 U	0.04 J	- -	0.2 U	- -	0.1 U	0.21 U
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	10 U	10 U	- -	2.5 B	- -	2.6 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	10 U	- -	10 U	- -	2.8 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	27100	- -	- -	- -	7560 E	- -	- -	39000
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	40 U	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	0.87 U	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.2-3. Detected Chemicals in Groundwater—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-601				L1-TTTW-001	L1-TTTW-003	L1-TTTW-005	
					Sample ID	JAW-601-20010619	JAW-601-20020612	JAW-601-20030603	JAW-601-5002014	L1-TTTW-001	L1-TTTW-003	L1-TTTW-005-11192011	L1-TTTW-005-11212011
					Sample Depth (ft)	57 - 67	57 - 67	57 - 67	57 - 67	8 - 12	8 - 12	5 - 10	5 - 10
					Sample Date	6/19/2001	6/12/2002	6/3/2003	5/26/2014	11/5/2006	11/5/2006	11/19/2011	11/21/2011
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	480000	460000	450000	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	1500	1500	1600	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	55000	200000	52000	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	8000	1000 U	220 U	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	2300	2300	2600	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	4000	2500	2300	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	1000	1000	1000	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	40	10 U	50 U	33 U	- -	- -	- -	590
ANIONS	14808-79-8	Sulfate	µg/L	--	--	1000 U	1000 U	1000 U	600 U	- -	- -	- -	7300
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.37 U	0.42 U	0.92 U	0.19 U	- -	- -	132	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	0.19 U	- -	- -	48 U	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	0.19 U	- -	- -	22.7 J	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.3 U	0.34 U	0.92 U	0.19 U	10.5	0.23 U	283	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.3 U	0.34 U	0.92 U	0.19 U	1.7	0.23 U	*3380*	- -
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.3 U	0.34 U	0.92 U	0.19 U	0.21 U	0.23 U	48 U	- -
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	3.4 J	10 U	10 U	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	1450	485	624	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	5 U	5 U	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	87800	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	0.5 J	10 U	0.92 J	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	- -	109 B	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	3.2 J	10 U	10 U	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	35900	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	- -	145	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	0.2 U	0.02 J	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	10 U	3.7 J	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	10 U	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	48100	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.2-3. Detected Chemicals in Groundwater—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

					Location	L1-TTTW-005	L1-TTTW-006			L1-TTTW-007	
					Sample ID	L1-TTTW-005-5002014	L1-TTTW-006-11192011	L1-TTTW-006-11212011	L1-TTTW-006-5002014	L1-TTTW-007-11192011	L1-TTTW-007-11212011
					Sample Depth (ft)	5 - 10	5 - 10	5 - 10	5 - 10	5 - 10	5 - 10
					Sample Date	5/12/2014	11/19/2011	11/21/2011	5/12/2014	11/19/2011	11/21/2011
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])						
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	μg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	1100	- -	- -	170	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	- -	- -	51100	- -	- -	47200
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.19 U	9.8 U	- -	0.19 U	0.19 U	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	27.7	14.8	- -	3.5	0.25	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.65	9.8 U	- -	0.19 U	0.19 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	μg/L	2.5	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.19 U	9.8 U	- -	0.19 U	0.19 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	μg/L	0.24	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.19 U	9.8 U	- -	0.19 U	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	*2.6*	*9.5 J*	- -	1.8	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.19 U	9.8 U	- -	0.19 U	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	*4.1*	*10.2*	- -	*2.5*	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	μg/L	1.9	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.19 U	9.8 U	- -	0.19 U	0.19 U	- -
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.19 U	9.8 U	- -	0.19 U	0.19 U	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	4	9.8 U	- -	0.45	0.19 U	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	311	936	- -	340	3.5	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	μg/L	1000	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	*1680*	*737*	- -	*190*	*4.4*	- -
EXPLOSIVES	121-82-4	RDX, dissolved	μg/L	2	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.19 U	9.8 U	- -	0.19 U	0.19 U	- -
METALS	7429-90-5	Aluminum	μg/L	20000	11272	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	μg/L	10	--	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	μg/L	14000	--	- -	- -	35 U	- -	- -	35 U
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	μg/L	430	--	- -	- -	4.4 J	- -	- -	13.5 J
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	μg/L	18000	--	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	μg/L	80	--	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -

Table 5.2-3. Detected Chemicals in Groundwater—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
					Location	L1-TTTW-008		SL-81					
					Sample ID	L1-TTTW-008-11192011	L1-TTTW-008-11212011	SL-81-20001116	SL-81-20010530	SL-81-20020605	SL-81-20030602	SL-81-20040603	F04-GW-001
					Sample Depth (ft)	9 - 14	9 - 14	5.51 - 10.5	5.51 - 10.5	5.51 - 10.5	5.51 - 10.5	5.51 - 10.5	5.51 - 10.5
					Sample Date	11/19/2011	11/21/2011	11/16/2000	5/30/2001	6/5/2002	6/2/2003	6/3/2004	11/10/2004
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	400000	220000	290000	300000	300000	360000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	10 U	10 U	40	20 U	40 J	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	190000	80000	130000	130000	180000	3800
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	300 U	2100	1000 U	23000	1000 U	1000 U	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	400	300 U	300 U	300 U	1000	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	1900	1900	2500	2100	2300 J	2900
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	130000	12000	6000	6000	11000	13000
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	400
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	160	- -	10 U	580	650	680	850 J	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	27100	28000	26000	30000	33000	45000	63000
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	0.48 U	0.5 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	- -	0.73 U	12	4.1	2.7 J	2 J	2.6
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	0.48 U	0.5 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	0.48 U	0.5 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	0.48 U	0.5 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	0.48 U	0.5 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	20 U	0.5 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	0.48 U	0.5 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	0.48 U	0.5 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	- -	- -	- -	- -	- -	- -	0.5 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	- -	- -	- -	- -	- -	- -	0.5 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.73	- -	6.1	31	18	17	12	20
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	- -	0.5	*200*	*120*	*67*	*45*	*65 D*
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	- -	0.73 U	0.53 U	0.73 U	0.35 U	0.48 U	0.5 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -	- -	- -	- -	500 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	10 U	10 U	10 U	10 U	20 U	20 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	506	199 J	287 J	244	259	374
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	0.3 J	5 U	5 U	0.41 U	5 U	0.41 B
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	145000	69900	- -	- -	- -	105000
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	1.5 J	1.2 J	10 U	3.1 J	10 U	0.59 B
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	15.6 B
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	35 U	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	10 U	10 U	10 U	10 U	10 U	3.6 B
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	51400	22500	- -	- -	- -	38500
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	32.9
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	*876*	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	0.21 U	0.21 U	0.2 U	0.2 U	0.2 U	0.2 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	10 U	10 U	10 U	10 U	10 U	3.1 B
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	10 U	10 U	10 U	10 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	8200	4490 J	- -	- -	- -	5190 E
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	11 B
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	7.5
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.2-3. Detected Chemicals in Groundwater—Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, IA

					Location	SL-81			
					Sample ID	SL-81-1	SL-81-BL	SL-81-5	SL-81-2
					Sample Depth (ft)	5.51 - 10.5	5.51 - 10.5	5.51 - 10.5	5.51 - 10.5
					Sample Date	6/29/2006	7/12/2006	7/27/2006	6/28/2007
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])				
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	384000	320000	597000	538000
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	4000 U	10000	10000	18000
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene, dissolved	µg/L	2.5	--	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene, dissolved	µg/L	0.24	--	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	1.9	--	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	1.9	--	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.42	0.48	0.41	0.99
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	0.43	0.47	0.55	0.88
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.2 U	0.19 U	0.19 U	1.2
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	0.2 U	0.2 U	0.2 U	0.8
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	0.19 U	0.19 U	0.19 U
METALS	7429-90-5	Aluminum	µg/L	20000	11272	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -
METALS	7439-89-6	Iron, dissolved	µg/L	14000	--	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	430	--	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha	pCi/L	--	--	- -	- -	- -	- -
RADIONUCLIDE	12587-46-1	Gross Alpha, dissolved	pCi/L	--	--	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta	pCi/L	--	--	- -	- -	- -	- -
RADIONUCLIDE	12587-47-2	Gross Beta, dissolved	pCi/L	--	--	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -

Notes:

DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

RDX = 1,3,5-trinitro-1,3,5-triazine

TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol

B = The analyte was detected in the associated method and/or calibration blank.

D = Diluted sample.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

M = Manual integrated compound

P = Sample failed confirmation precision criteria.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

-- = Not analyzed

µg/L = Micrograms per Liter

pCi/L =picocuries per liter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M 2020a)

(1) UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.2-4. Detected Chemicals in Surface Water
Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, IA

					Location	BC11-H		BC2					BC3		BC3		
					Sample ID	BC11-H-20000524	BC11-H-20000927	BC2-20010602-WS	BC2-20020615-WS	BC2-20030516-WS	BC2-20031116-WS	BC2-20040607-WS	BC3-20010602-WS	BC3-20020615-WS	BC3-20030516-WS	BC3-20031116-WS	BC3-20040607-WS
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	5/24/2000	9/27/2000	6/2/2001	6/15/2002	5/16/2003	11/16/2003	6/7/2004	6/2/2001	6/15/2002	5/16/2003	11/16/2003	6/7/2004
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])												
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	4460000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	11	--	0.24 U	0.21 U	0.81 U	0.51 U	0.42 U	1.3 U	0.48 U	0.29 U	0.75 U	0.42 U	1.6 U	0.49 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	1 J	0.63 U	0.42 U	1.3 U	0.48 U	0.23 J	0.94 U	0.42 U	1.6 U	0.49 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	18	--	0.48 U	0.42 U	0.44 JP	0.3 J	0.34 JP	1.3 U	0.48 U	0.15 J	0.75 U	0.42 U	1.6 U	0.49 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	18	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	11	--	0.48 U	0.42 U	0.44 JP	0.62 J	0.54 P	1.3 U	0.27 J	0.27 J	0.46 J	0.27 JP	1.6 U	0.49 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	11	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	220	--	5.2	0.53 E	4.5	6.5 J	7.1	2.5 P	3.9	2.8	5.7 J	5.7	5.7	3.9
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	220	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	79	--	4.5	15	9	13	11	4.6 P	7.1	5.2	9.5	7.9 P	9.9	5.5
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	79	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7429-90-5	Aluminum	µg/L	87	5900	*921*	*385 J*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7429-90-5	Aluminum, dissolved	µg/L	87	75	43.6 J	19.4 UJ	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-36-0	Antimony, dissolved	µg/L	190	4	8.4 J	2.9 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	11.7	8	2.4 U	2.9 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	220	236	130	127 J	140 J	*321 J*	128 J	104 J	167 J	141 J	126 J	133 J	108 J	167 J
METALS	7440-39-3	Barium, dissolved	µg/L	220	210	121	96.5 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	64.1	0.4	0.4 U	0.2 U	0.5 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
METALS	7440-43-9	Cadmium, dissolved	µg/L	64.1	0.4	0.4 U	0.2 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	116000	--	54300	55200 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium, dissolved	µg/L	116000	--	50600	44800 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	0.66	6.4	*2.2 J*	1.1 U	*4.1 J*	*3 J*	*3.9 J*	*2.9 J*	10 U	*2.7 J*	*2.6 J*	10 U	*2.1 J*	10 U
METALS	7440-47-3	Chromium, dissolved	µg/L	0.66	8	*2.1 J*	1.1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-50-8	Copper	µg/L	1000	5.4	2.6 U	1.1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-50-8	Copper, dissolved	µg/L	1000	4.6	2.6 U	1.1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	--	3.3	2.4 J	1.3 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	2.4 J
METALS	7439-95-4	Magnesium	µg/L	82000	--	19400	16800 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium, dissolved	µg/L	82000	--	18700	13800 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	93	120	69.9	60.6 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	93	170	47	21.1 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-02-0	Nickel	µg/L	4600	5	8 J	1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-02-0	Nickel, dissolved	µg/L	4600	2.2	1.7 U	1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	53000	--	1540	2820	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium, dissolved	µg/L	53000	--	1430	2270	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver, dissolved	µg/L	4020	1.8	2.8 U	1.7 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	680000	--	22900	21200 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium, dissolved	µg/L	680000	--	21400	16700 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-28-0	Thallium, dissolved	µg/L	0.47	1.8	*4.6 J*	3.4 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-62-2	Vanadium	µg/L	27	12	4.1 J	4.9 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-62-2	Vanadium, dissolved	µg/L	27	8	1.6 U	3.4 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	26000	18	8.5 J	12.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc, dissolved	µg/L	26000	15	2 J	0.7 J	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.2-4. Detected Chemicals in Surface Water
Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, IA

					Location	BC-TTSW-016					L1-TTSW-027	OU3-SW03	OU3-SW04	OU3-SW07	OU3-SW08	Site 12	Site 13
					Sample ID	BC-TTSW-016-1	BC-TTSW-016-BL	BC-TTSW-016-5	BC-TTSW-016-5-FD	BC-TTSW-016-2	L1-TTSW-027-11102011	OU3-SW03-0319	OU3-SW04-0319	OU3-SW07-1219	OU3-SW08-1219	BC03-12-WS	BC02-13-WS
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	6/23/2006	7/9/2006	7/26/2006	7/26/2006	6/25/2007	11/10/2011	3/19/2019	3/19/2019	12/11/2019	12/11/2019	10/13/2003	10/13/2003
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])												
GENERAL	TDS	Total dissolved solids	µg/L	--	--	231000	266000	483000	523000	403000	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	4000 B	10000	129000	75000	50000	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	4460000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	11	--	0.22 U	0.2 U	0.19 U	0.19 U	0.19 U	0.2 U	0.41 U	0.4 U	0.41 U	0.42 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	- -	- -	0.16 J	0.29 U	0.29 U	0.36 J	0.37 J	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	18	--	0.22 U	0.2 U	0.076 J	0.08 J	0.12 J	0.18 J	0.082 J	0.12 U	0.12 J	0.087 J	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene, dissolved	µg/L	18	--	0.23 U	0.2 U	0.073 J	0.071 J	0.2 U	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	11	--	0.22	0.17 J	0.25	0.29	0.38	0.75	0.2 J	0.21	0.35	0.34	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene, dissolved	µg/L	11	--	0.2 J	0.14 J	0.23	0.22	0.2 U	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	220	--	5.6	2.4	6.8	6.8	3.6	21.2	2.2	2.1	13	14	- -	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	220	--	3.9	2.3	7.3	8	0.2 U	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	79	--	6.1	3	7.4	7.6	6.2	22.5	12	11	26	28 J	9.57	13
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	79	--	5.1	3	8.3	9.2	0.2 U	- -	- -	- -	- -	- -	- -	- -
METALS	7429-90-5	Aluminum	µg/L	87	5900	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7429-90-5	Aluminum, dissolved	µg/L	87	75	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-36-0	Antimony, dissolved	µg/L	190	4	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	11.7	8	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	220	236	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium, dissolved	µg/L	220	210	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	64.1	0.4	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium, dissolved	µg/L	64.1	0.4	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	116000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium, dissolved	µg/L	116000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	0.66	6.4	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium, dissolved	µg/L	0.66	8	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-50-8	Copper	µg/L	1000	5.4	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-50-8	Copper, dissolved	µg/L	1000	4.6	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	--	3.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	82000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium, dissolved	µg/L	82000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	93	120	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	µg/L	93	170	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-02-0	Nickel	µg/L	4600	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-02-0	Nickel, dissolved	µg/L	4600	2.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	53000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium, dissolved	µg/L	53000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver, dissolved	µg/L	4020	1.8	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	680000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium, dissolved	µg/L	680000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-28-0	Thallium, dissolved	µg/L	0.47	1.8	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-62-2	Vanadium	µg/L	27	12	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-62-2	Vanadium, dissolved	µg/L	27	8	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	26000	18	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc, dissolved	µg/L	26000	15	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.2-4. Detected Chemicals in Surface Water—Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, IA

Notes:

DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

B = The analyte was detected in the associated method and/or calibration blank.

P = Sample failed confirmation precision criteria.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

µg/L = micrograms per liter

-- = Not Analyzed

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable

*Screening level is the lower of the selected Human Health and Ecological screening

Source: EPA's Regional Screening Levels (September 2022). Available online: https:/

Source: Background threshold values (BTVs) from *Evaluation of Background Concen*

(1) UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.2-5. Detected Chemicals in Sediment—Line 1 Impoundment
Iowa Army Ammunition Plant, Middletown, IA

					Location	BC11-H	BC-TTSD-034		BC-TTSD-035	BC-TTSD-036	Site 12	Site 13
					Sample ID	BC11-H-20000927-SD	BC-TTSD-034	BC-TTSD-034-FD	BC-TTSD-035	BC-TTSD-036	BC03-12-SD	BC02-13-SD
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	9/27/2000	3/23/2006	3/23/2006	3/23/2006	3/23/2006	10/13/2003	10/13/2003
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
GENERAL	SOLID	Solids	%	--	--	- -	73.1	72.5	68.8	61.3	- -	- -
GEOTECH	FINES	Fine Fraction	%	--	--	- -	67.1	64.6	68.9	68.1	- -	- -
GEOTECH	GRAVEL	Gravel Fraction	%	--	--	- -	0	0	0	0	- -	- -
GEOTECH	SAND	Sand Fraction	%	--	--	- -	32.9	35.4	31.1	31.9	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	mg/kg	0.027	--	0.1 U	0.24 U	0.25 U	*0.342*	0.25 U	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	mg/kg	0.047	--	0.2 U	0.24 U	0.25 U	*0.359*	0.25 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	mg/kg	0.028	--	0.2 U	0.24 U	0.25 U	*0.271*	0.25 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	mg/kg	0.108	--	0.25 U	*0.207 J*	*0.23 J*	0.23 U	*0.195 J*	- -	- -
EXPLOSIVES	121-82-4	RDX	mg/kg	0.065	--	0.1 U	*0.945*	*0.105 J*	*0.366*	0.25 U	0.04 U	0.04 U
METALS	7429-90-5	Aluminum	mg/kg	--	16000	4790	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	mg/kg	9.8	18.6	2.2	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	mg/kg	20	440	*70*	- -	- -	- -	- -	- -	- -
METALS	7440-41-7	Beryllium	mg/kg	12400	1.01	0.3 J	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	mg/kg	--	--	3130	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	mg/kg	43.4	30.7	7.8	- -	- -	- -	- -	- -	- -
METALS	7440-48-4	Cobalt	mg/kg	50	23.7	3.8	- -	- -	- -	- -	- -	- -
METALS	7440-50-8	Copper	mg/kg	31.6	35.9	6.6	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	mg/kg	20000	32300	7830	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	mg/kg	35.8	28.8	7.3	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	mg/kg	--	--	1280	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	mg/kg	460	2300	235	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	mg/kg	0.18	0.035	0.06	- -	- -	- -	- -	- -	- -
METALS	7440-02-0	Nickel	mg/kg	22.7	31.5	6.7	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium	mg/kg	--	--	539	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	mg/kg	--	--	729 J	- -	- -	- -	- -	- -	- -
METALS	7440-62-2	Vanadium	mg/kg	31300	49.7	14.1	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	mg/kg	121	113	23.7	- -	- -	- -	- -	- -	- -

Notes:

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

RDX = 1,3,5-trinitro-1,3,5-triazine

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

mg/kg = Milligrams per Kilogram

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable

-- = Not analyzed

*Screening level is the lower of the selected Human Health and Ecological screening levels (see Appendix F).

Source: EPA's Regional Screening Levels (September 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: Background threshold values (BTVs) from *Evaluation of Background Concentrations of Metals in Sediment and Surface Water* (CH2M, 2020b)

[1] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.2-6. Groundwater Quality Parameters—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (µS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
G-14	11/15/2018	1.06	7.59	11.1	760	-94.8	0.7	6.28
GZ-2A	11/15/2018	5.27	7.33	12.8	890	-106.9	0.42	9.21
GZ-2	11/15/2018	0.14	7.84	12.6	740	-131.3	0.64	17.6
GZ-3	11/15/2018	2.30	7.51	12	860	-88.5	0.6	2.48

Notes:

Water quality parameters were measured in the field using a YSI multi-meter.

°C = degrees Celsius
DO = dissolved oxygen
mV = millivolt(s)
NTU = nephelometric turbidity unit
ORP = oxidation-reduction potential
µg/L = microgram(s) per liter
µS/cm = microsiemen(s) per centimeter
ft = feet
btoc = below top of casing

Table 5.2-8. Data Groupings Used in the HHRA—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Description	Sample Count
AOC_GW	Groundwater	20
AOC_GW-CW	Shallow groundwater (DTW ≤10 feet bgs) in trench/culvert	20
AOC_SW	Brush Creek Surface Water	8
AOC_SD	Brush Creek Sediment	6

Note:

bgs - below ground surface

DTW - depth to water

Table 5.2-9. Samples Used in the HHRA—Line 1 Impoundment

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_SW		WS	BC2	BC2-20040607-WS	6/7/2004	0	0
AOC_SW		WS	L1-TTSW-027	L1-TTSW-027-11102011	11/10/2011	0	0
AOC_SD		SE	BC11-H	BC11-H-20000927-SD	9/27/2000	0	0
AOC_SD		SE	BC-TTSD-034	BC-TTSD-034	3/23/2006	0	0
AOC_SD		SE	BC-TTSD-035	BC-TTSD-035	3/23/2006	0	0
AOC_SD		SE	Site 12	BC03-12-SD	10/13/2003	0	0
AOC_SD		SE	Site 13	BC02-13-SD	10/13/2003	0	0
AOC_SD		SE	BC-TTSD-036	BC-TTSD-036	3/23/2006	0	0
AOC_GW	AOC_GW-CW	WG	G-14	G-14-5002014	5/19/2014	26	36
AOC_GW	AOC_GW-CW	WG	G-14	G-14-1118	11/15/2018	26	36
AOC_GW	AOC_GW-CW	WG	GZ-1	GZ-1-5002014	5/14/2014	40	50
AOC_GW	AOC_GW-CW	WG	GZ-2	GZ-2-5002014 (2)	5/19/2014	20	30
AOC_GW	AOC_GW-CW	WG	GZ-2	GZ-2-1118 (2)	11/16/2018	20	30
AOC_GW	AOC_GW-CW	WG	GZ-2A	GZ-2A-5002014 (2)	5/15/2014	5	10
AOC_GW	AOC_GW-CW	WG	GZ-2A	GZ-2A-1118 (2)	11/16/2018	5	10
AOC_GW	AOC_GW-CW	WG	GZ-3	GZ-3-5002014	5/19/2014	36	46
AOC_GW	AOC_GW-CW	WG	GZ-3	GZ-3-1118	11/15/2018	36	46
AOC_GW	AOC_GW-CW	WG	JAW-43	JAW-43-5002014	5/9/2014	12	17
AOC_GW	AOC_GW-CW	WG	JAW-44	JAW-44-5002014	5/9/2014	5	10
AOC_GW	AOC_GW-CW	WG	JAW-601	JAW-601-5002014	5/26/2014	57	67
AOC_GW	AOC_GW-CW	WG	L1-TTTW-001	L1-TTTW-001	11/5/2006	0	0
AOC_GW	AOC_GW-CW	WG	L1-TTTW-003	L1-TTTW-003	11/5/2006	0	0
AOC_GW	AOC_GW-CW	WG	L1-TTTW-005	L1-TTTW-005-5002014 (2)	5/12/2014	5	10
AOC_GW	AOC_GW-CW	WG	L1-TTTW-006	L1-TTTW-006-5002014 (2)	5/12/2014	5	10
AOC_GW	AOC_GW-CW	WG	L1-TTTW-007	L1-TTTW-007-11192011 (2	11/19/2011	5	10
AOC_GW	AOC_GW-CW	WG	L1-TTTW-007	L1-TTTW-007-11212011 (2	11/21/2011	5	10
AOC_GW	AOC_GW-CW	WG	L1-TTTW-008	L1-TTTW-008-11192011	11/19/2011	9	14
AOC_GW	AOC_GW-CW	WG	L1-TTTW-008	L1-TTTW-008-11212011	11/21/2011	9	14
AOC_SW		WS	BC11-H	BC11-H-20000524	5/24/2000	0	0
AOC_SW		WS	BC11-H	BC11-H-20000927	9/27/2000	0	0
AOC_SW		WS	BC3	BC3-20040607-WS	6/7/2004	0	0
AOC_SW		WS	BC-TTSW-016	BC-TTSW-016-2	6/25/2007	0	0
AOC_SW		WS	Site 12	BC03-12-WS	10/13/2003	0	0
AOC_SW		WS	Site 13	BC02-13-WS	10/13/2003	0	0

Notes:

(1) The data were reduced such that when a normal and duplicate sample were available, the highest detected concentration among normal or duplicate samples was used when a chemical was detected in any sample. If both results were non-detect, the lowest reported detection limit (i.e., reporting limit) was used.

(2) Samples located within the core of the RDX plume were used to calculate plume exposure point concentrations.

SE = sediment

WG = groundwater

WS = surface water

Table 5.3-1. Previous Investigations/Remedial Actions—Line 2

Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Installation Assessment of IAAAP (USATHAMA, 1980)	1980	A records search was conducted to assess the use, storage, treatment, and disposal of toxic and hazardous materials at IAAAP in regard to environmental quality.	The records search indicated loading activities began on Line 2 in 1941. Line 2 was identified as a conventional LAP facility and was previously used as a missile-loading facility. Outfall 002 was noted to consist of explosives-contaminated wastewater from Line 2. A follow-on preliminary survey was recommended to define the level of contaminants that may be migrating beyond the installation boundaries.
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	1991	A preliminary assessment was conducted at Line 2 to evaluate the potential for contamination and assess potential migration pathways and exposure potential if contamination were present.	The preliminary assessment indicated there was a potential for contamination at Line 2. The wastes found were predominantly explosives: TNT, RDX, and Composition B. Other wastes that may be present are organics, mainly solvents and oils. It was recommended that samples be taken around buildings, which had the potential for spills in the past.
Facility-wide Site Inspection (JAYCOR, 1992)	1991	Six soil samples (one grab and five composite) were collected in the areas of the buildings where feedstocks and wastes were handled: melt buildings (2-05-1 and 2-05-2); pumphouse building (2-140); radiographic building (2-100); wastewater treatment buildings (2-70-1 and 2-70-2); and load and storage areas. Samples were analyzed for VOCs, SVOCs, explosives, and metals. Two sediment samples were collected and analyzed for metals.	Low levels of metals were reported in all samples collected, with the highest concentrations of metals west of Filter House 2-70-2, in soil at the southeast corner of Filter House 2-70-1, and in an area adjacent to a support pillar northeast of Building 2-80-1. One sample collected near Building 2-08-2 also contained low levels of HMX and RDX. Copper, chromium, mercury, and zinc were detected in sediment samples.
Facility-wide Phase I and Follow-on Remedial Investigation (JAYCOR, 1993a, 1996)	1992–1995	Soil gas screening was conducted around two areas within Line 2 (Building 2-05-2 and Building 2-03). Thirty-four soil gas samples were collected to assess VOCs. Twenty-six environmental surface soil samples were collected at Line 2 and analyzed for VOCs, SVOCs, pesticides/PCBs, explosives, and metals. Soil samples were also collected for field screening of explosives and metals. A total of 833 soil samples were collected, 589 for metals analysis and 244 for explosives analysis. Twenty-three explosives screening samples and 59 metals screening samples were also sent for laboratory confirmation. A total of 44 soil samples were collected and analyzed for explosives and metals from sumps at Line 2.	Soil gas screening at Building 2-05-2 indicated no VOC concentrations above detections limits, while concentrations ranged from nondetect to 1,950 ppb at Building 2-03. Total VOCs were detected in 9 out of 34 samples. Metals, VOCs, SVOCs and explosives were detected in surface soil samples around Buildings 2-13 and 2-15. Explosives and metals above the evaluation criteria were identified in the loading dock area, near building foundations, and sumps at Line 2, with contamination decreasing with depth. No contamination was observed below 6 feet bgs. Copper, iron, magnesium, manganese, bis(2-ethylhexyl)phthalate, chloroform, and RDX were detected in surface water and chromium, mercury, beryllium,

Table 5.3-1. Previous Investigations/Remedial Actions—Line 2
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
		Three surface water/sediment samples were collected at Line 2 and analyzed for VOCs, SVOCs, explosives and metals. A basewide survey was also conducted and five surface water samples and six sediment samples were collected in the vicinity of Line 2. Surface water and sediment samples were collected from drainage ditches around Line 2 Buildings 2-140-7, 2-70-2, and 2-82-19 and from Brush Creek in the vicinity of Line 2. Three surface water/sediment samples were also collected from the basement of Building 2-05-1 and two surface water/sediment samples were collected from the basement of Building 2-05-2 during follow-on sampling. Five piezometers were installed. Groundwater samples were collected from three piezometers (PZ-29, PZ-30, and PZ-31) for analysis of explosives. Groundwater was collected from two piezometers (PZ-35 and PZ-36) for analysis of metals and VOCs. Hydrodynamic dispersion of contaminates was calculated using the hydraulic gradient (0.01 ft/ft) and times since contaminant release (20 years and 50 years) to predict concentrations at distances from the initial release. Six monitoring wells (JAW-70 through JAW-75) were installed at Line 2. Groundwater samples were analyzed for metals and explosives.	magnesium, thallium, and pyrene were detected in sediment above evaluation criteria. Chromium, iron, manganese, and a plastic-related compound, methylethyl phenol/methylethyl were detected in groundwater at piezometer PZ-36, downgradient of sump and melt Building 2-03. Results from hydrodynamic dispersion calculations also suggested contamination from Line 2 was discharging to Brush Creek. Explosives were detected in groundwater from newly installed monitoring wells, with maximum RDX concentrations of 1,600 µg/L at JAW-62. Elevated levels of RDX, 2,4-DNT, HMX, and nitrobenzene were detected at downgradient wells JAW-70 through JAW-73. The probable source of explosives was identified to be discharges from permitted NPDES outfalls near well locations. The RI recommended semiannual compliance groundwater monitoring at Line 2 for explosives and metals for compliance with the hazardous waste management regulations for permitted facilities (40 CFR Part 264), specifically, Subpart F of these regulations, Releases from Solid Waste Management Units. It was also noted Line 2 would be evaluated during the groundwater FS.
Periodic Groundwater and Surface Water Monitoring (multiple reports)	1994–2007	Periodic groundwater and surface water sampling was conducted at Line 2 per the FFA and recommendations in the 1996 RI. Samples were analyzed for explosives and metals.	Explosives and metals were detected, but groundwater plumes were generally stable. Evidence for favorable conditions for biological reduction of contaminants exists at Line 2; however, other factors may be constraining biodegradation processes. Explosives were last sampled in 2006 and arsenic was last sampled in 2007. During the fall 2006 event, RDX was detected at a maximum concentration of 36.5 µg/L. During the 2007 event, dissolved arsenic was detected at a maximum concentration of 33.1 µg/L.

Table 5.3-1. Previous Investigations/Remedial Actions—Line 2

Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Soil and Sump Removal Action (OHM, 1996)	1995	Seven sumps, the West Recirculation Tank, and soil were removed. Sumps had been located at former Buildings 2-05-1, 2-05-2, 2-06-1, and 2-50, and the tank had been located to the west of former Building 2-05-1. Ninety-eight cubic yards of metals and explosives contaminated soil and material were removed.	While sediment collected in the sumps and soil surrounding the sumps exceeded screening criteria for lead, RDX, 2,4,6-TNT, and HMX, the screening criteria used were lower than the OU-1 RGs. It was assumed that the excavations removed all soil above screening criteria.
Supplemental Groundwater Remedial Investigation (MWH, 2001)	1997	Groundwater samples were collected from 6 temporary wells and from 12 existing monitoring wells and analyzed for VOCs, SVOCs, explosives, and metals.	Methylene chloride (five locations), BEHP (three locations), and TCE (one location) exceed screening levels. Methylene chloride and BEHP were attributed to laboratory contamination and the TCE source was unknown. RDX was detected above the screening criteria at seven locations. 1,3-dinitrobenzene and 2,4-DNT were detected at one location. Dissolved arsenic was detected above screening level at one location. It was concluded that the downgradient extent of RDX contamination was uncertain.
Record of Decision for Soils OU-1 (Department of the Army and USEPA, 1998; Harza, 1998)	1998	The Final ROD for OU-1 was issued to address contaminated soils at IAAAP. The ROD presented the selected remedial action for OU-1.	The selected remedy included excavation of soil from 18 areas at Line 2 containing explosives and lead greater than RGs.
Groundwater Monitoring Program (Harza, 2001)	2001	The Groundwater Monitoring Program was established for on-going monitoring at IAAAP. Wells at Line 2 were identified to be sampled for explosives and natural attenuation parameters.	Line 2 was included in the Groundwater Monitoring Program at IAAAP.
Line 2 Groundwater Feasibility Study Feasibility Study Data Collection and Remedial Alternatives Analysis (URS, 2003b, 2004a; HydroGeoLogic, 2003)	2002–2003	To support the development of a Feasibility Study for Line 2, a field survey, geologic soil logging and geotechnical sampling, DPT groundwater sampling, monitoring well installation and sampling, staff gauge installation, aquifer slug testing, and surface water sampling were conducted. Forty-eight groundwater samples were collected from 24 DPT borings and analyzed for explosives. Five new monitoring wells (L2-MW4 through L2-MW8) were installed. The five new monitoring wells and 17 existing monitoring wells were sampled for explosives, metals, and natural attenuation parameters. The report also considered the periodic groundwater monitoring data from 17 existing wells.	In groundwater, two separate explosives plumes were identified: a Line 2 plume and a Brush Creek plume. RDX and HMX were detected most frequently. Within the Line 2 boundary, the plume was identified near the explosives melt buildings and the NPDES wastewater outfalls. Along Brush Creek, a smaller RDX plume was identified next to a 12-inch water line that crossed Brush Creek and monitoring well G-15. This plume was not considered to be connected with the contamination at Line 2. No explosives exceedances were identified in the deepest monitoring wells. Groundwater was considered adequately characterized and no data gaps were identified.

Table 5.3-1. Previous Investigations/Remedial Actions—Line 2
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
		Sixteen surface water samples were collected during two events in May 2003 from Brush Creek (nine surface water samples aligned the Line 2 boundary, three surface water samples upgradient of Line 2, and three surface water samples downgradient). Surface water samples were analyzed for explosives only on May 7 and for explosives and metals on May 16. Four staff gauges were installed in Brush Creek. Groundwater flow and contaminant fate and transport in the saturated zone at Line 2 was modeled using the MODFLOW and MT3DMS numerical computer modeling programs, respectively. A risk assessment was completed to assess potential risk to human health associated with current or future exposures to groundwater at Line 2.	In surface water, the contamination was attributed to upstream sources and not associated with the Line 2 RDX plume. The highest concentration (23 µg/L) was observed downstream from monitoring well G-15.The groundwater fate and transport model predicted that RDX concentrations in groundwater would continue to decline over time (except for the area around JAW-72) due to the naturally occurring processes of dispersion and biodegradation. The Line 2 RDX plume could continue to migrate another 100 feet, but the Brush Creek plume will not migrate any significant distance. The initial natural attenuation evaluation indicated that conditions could be favorable for reductive degradation of RDX. In general, concentrations had decreased and the plume had not spread. However, the model suggested there could be a continuing source near JAW-72, which could hinder natural attenuation. RDX was identified as final chemical of concern (COC) for groundwater. Following the risk assessment, four remedial alternatives were evaluated to prevent commercial/ industrial worker ingestion of RDX in groundwater for inclusion in the FS report.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	2005	A comprehensive evaluation was conducted of all IAAAP sites and the four primary watersheds (Brush Creek, Spring Creek, Long Creek, and Skunk River) to identify data gaps and additional data needed to complete a feasibility study for surface water and groundwater at each of the IAAAP sites.	The Work Plan concluded that data gaps were present around G-15 and the south Brush Creek plume. Further investigation around the sewer line upgradient of G-15 was warranted.
Remedial Action for OU-1 Soils Phase 5, 7, and 8 Sites (Tetra Tech, 2009a; USACE-Baltimore, 2016)	2006	A total of 3,170 cubic yards of contaminated soil were removed from 23 excavations at Line 2 to a maximum depth of 14 feet bgs. Some areas required two or more phases of excavation and subsequent confirmation sampling to remove all contamination.	Confirmation sampling indicated all contaminated soil was removed except at two excavations: the north wall of excavation (L2-E13) north of Building 2-99-6 and the floor of excavation (L2-E10) north of Building 2-05-1. Given that the excavation at L2-10 was terminated below the water table, it was concluded that the residual soil contamination in the floor of L2-E10 were likely related to the RDX groundwater plume at the site. Contamination at excavation L2-E13 could not be removed without undermining the foundation of a vacuum house.

Table 5.3-1. Previous Investigations/Remedial Actions—Line 2
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Supplemental Remedial Investigation Sampling (Tetra Tech, 2012a)	2006–2007	Three DPT soil samples were collected around G-15 and analyzed for explosives. Three temporary wells were installed at Line 2. One temporary well was dry, but groundwater samples were collected from two locations around G-15 to delineate RDX contamination. Groundwater was analyzed for explosives.	No explosives contamination was detected in soil during this investigation. A potential source for the contamination at G-15 may be backfilled material from an installed water line originating from the CCL. Groundwater results did not indicate that RDX at G-15, along Brush Creek, was connected to Line 2.
Groundwater Treatability Study (Tetra Tech, 2010)	2007–2009	A groundwater treatability study was conducted at Line 2 to test the efficacy of in situ bioremediation at reducing the highest level of explosives contamination. Two new monitoring wells (L2-TT-MW01 and L2-TT-MW02) were installed. Approximately 300 gallons of a 20 percent high-fructose corn syrup solution were injected into 25 DPT injection points in September and October 2007. Two source areas monitoring wells and three downgradient monitoring wells were monitored during the study.	It was concluded the addition of a carbon amendment enhanced the natural degradation process of explosives in groundwater at Line 2. Additional injections were recommended at Line 2, to target the RDX plume northwest of Building 2-05-1.
Explanation of Significant Differences for the Records of Decision Soils OU-1 (Leidos, 2018)	2018	Documented the addition of LUCs to the selected remedy for the soils ROD to provide overall protectiveness of human health and the environment.	The Explanation of Significant Differences changes will apply to soil at Line 2.
OU-1 Land Use Controls Implementation Plan (Leidos, 2019)	2019	Outlined the process for implementation and maintenance of LUCs as a component of the selected remedy for OU-1. Institutional controls will be used to restrict land use at OU-1 areas to military, commercial/industrial, agricultural, and permitted hunting and prohibit residential use. Engineering controls (fencing, signs) will be used to prevent general access to areas.	The scope of the LUCIP applies to the Line 2.

Table 5.3-3. Monitoring Well Construction Details—Line 2

Iowa Army Ammunition Plant, Middletown, IA

Well Location	Screen Interval (feet bgs)	Filter Pack Interval (feet bgs)	Borehole Depth (feet bgs)	Well Casing Diameter (inches)	Top of Casing Elevation (feet amsl)
L2-MW9	9 to 19	7 to 20	20	2	687.16
L2-MW10	40 to 50	38 to 50	50	2	666.78
L2-MW11	5.5 to 15.5	2.9 to 15.5	17	2	657.01

Notes:

Borehole diameter was 8 inches for monitoring wells L2-MW9 and -MW10 and unspecified for monitoring well L2-MW11.

amsl = above mean sea level
bgs = below ground surface

Table 5.3-4. Gauging Information—Line 2

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval	Depth to Water	Top of Casing Elevation	Groundwater Elevation
		(ft btoc)	(ft btoc)	(ft amsl)	(ft amsl)
G-15	8/28/2018	6.5-16.5	12.03	659.29	647.26
L2-TT-MW02	8/28/2018	10-20	6.5	NM	NA
JAW-70	8/28/2018	7-17	7.3	685.22	677.92
JAW-71	8/28/2018	7-17	9.61	684.61	675
JAW-72	8/28/2018	10-20	10.11	691.09	680.98
JAW-73	8/28/2018	10-20	12.42	692.41	679.99
JAW-74	8/28/2018	12-22	11.89	693.95	682.06
JAW-75	8/28/2018	7-17.5	12.54	691.97	679.43
12-A	8/28/2018	10.5-20.5	11.72	680.84	669.12
12-B	8/28/2018	10.5-20.5	10.64	691.02	680.38
12-C	8/28/2018	40.2-50.2	10.48	691.27	680.79
12-D	8/28/2018	120-130	21.97	690.87	668.9
12-E	8/28/2018	9.5-19.5	11.94	689.86	677.92
12-F	8/28/2018	40.4-50.4	8.28	690.22	681.94
12-G	8/28/2018	10.3-20.3	14.31	689.76	675.45
12-H	8/28/2018	28-30	NM[a]	689.602	NA
L2-MW1	8/28/2018	25-35	13.3	679.15	665.85
L2-MW2	8/28/2018	7.5-17.5	10.1	686.23	676.13
L2-MW3	8/28/2018	15-25	9.85	691.98	682.13
L2-MW4	8/28/2018	39-49	6.15	683.76	677.61
L2-MW5	8/28/2018	38.9-48.9	14.78	680.71	665.93
L2-MW6	8/28/2018	9.9-19.9	13.13	681.13	668
L2-MW7	8/28/2018	39.5-49.5	12.7	680.85	668.15
L2-MW8	8/28/2018	71.4-81.4	0	658.48	658.48
L2-MW9	8/28/2018	9-19	10.55	687.161	676.611
L2-MW10	8/28/2018	40-50	15.62	666.783	651.163
L2-MW11	8/28/2018	5.5-15.5	10.15	657.014	646.864

Notes:

[a]Well could not be located during 2018 gauging event.

ft = feet

btoc = below top of casing

amsl = above mean sea level

NA = Not Available

NM = Not Measured

Table 5.3-5. Detected Chemicals in Groundwater—Line 2

Iowa Army Ammunition Plant, Middletown, IA

					Location	12-A							12-B							
					Sample ID	H12A-010800	12A-052100	12-A-20001115	12-A-20010521	12-A-20020604	12-A-20030514	L2-A-0818	H12B-010800	12B-052000	12-B-20001114	12-B-20010518	12-B-20020604	12-B-20030514	F05-12-B-GW-REG	F06-12-B-GW-REG
					Sample Depth (ft)	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5	10.5 - 20.5
					Sample Date	1/8/2000	5/21/2000	11/15/2000	5/21/2001	6/4/2002	5/14/2003	8/28/2018	1/8/2000	5/20/2000	11/14/2000	5/18/2001	6/4/2002	5/14/2003	10/4/2005	9/5/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**															
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**242000**	- -	**230000**	**230000**	**240000**	**250000**	- -	**211000**	- -	**110000**	**180000**	**200000**	**200000**	**218000**	**208000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	100 U	- -	**10**	10 U	10 U	20 U	- -	100 U	- -	10 U	- -	10 U	20 U	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**215000**	- -	**13000**	**26000**	**110000**	**14000**	- -	**198000**	- -	**19000**	**75000**	88000 U	**36000**	**236000**	**257000**
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	***56***	- -	- -	- -	- -	- -	- -	29 UJ	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	1000 U	1000 U	**23000**	1000 U	- -	200 U	- -	1000 U	1000 U	**22000**	1000 U	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	- -	300 U	- -	300 U	**300**	- -	100 U	- -	300 U	**600**	**300**	300 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	1000 U	1000 U	1000 U	1000 U	- -	620 U	- -	**2300**	1000 U	1000 U	1000 U	560 B	**620 J**
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**1500**	- -	**1100**	**1000**	**1000**	**2000**	- -	**1900**	- -	1000 U	**1000**	**1000**	**1000**	1000 U	**7400 J**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**630**	**3000 J**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**850**	- -	**790**	- -	**860**	**890**	- -	50 U	- -	**70**	**100**	**720**	**290**	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	50 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**25500**	- -	**32000**	**26000**	**28000**	**28000**	- -	**50000**	- -	**53000**	**40000**	**42000**	**48000**	**34800**	**36900 J**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.64 U	1.3 U	0.55 U	1.1 U	0.1 U	0.03 U	0.16 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.64 U	1.6 U	0.68 U	1.1 U	0.1 U	- -	- -	**0.9 J**	**0.8**	**0.6 J**	**0.38**	**0.34**	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.64 U	1.3 U	0.55 U	1.1 U	0.1 U	0.04 U	0.16 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.64 U	1.3 U	0.55 U	1.1 U	0.1 U	0.05 U	0.16 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.64 U	1.3 U	0.55 U	1.1 U	0.1 U	0.05 U	0.31 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	0.64 U	1.3 U	0.55 U	1.1 U	0.1 U	0.03 U	0.31 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	ino-4,6-dinitrotoluene, diss	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.64 U	1.3 U	0.55 U	1.1 U	0.2 U	0.06 U	0.31 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.13 U	0.31 U	0.64 U	1.3 U	0.55 U	1.1 U	0.1 U	0.02 U	0.31 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	ino-2,6-dinitrotoluene, diss	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.2 U	- -	- -	- -	- -	- -	- -	**0.096 J**	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.1 U	- -	- -	- -	- -	- -	- -	**0.14 J**	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	0.64 U	1.3 U	0.55 U	1.1 U	**0.053 J**	**1.1**	**1.2 J**	**0.93 J**	**0.85**	0.91 U	**0.6**	**0.51**	**0.51**
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.64 U	1.3 U	0.55 U	1.1 U	0.1 U	0.06 U	0.16 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.69 U	0.16 U	**0.43 J**	1.3 U	**0.62 J**	1.1 U	**0.16**	2.8 U	***3.5 J***	***3.3***	***2.9***	***3 J***	**1.8 J**	**1.8**	**1.6**
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	2.4 U	**3 J**	10 U	10 U	10 U	- -	2.7 U	**2.7 J**	10 U	10 U	10 U	10 U	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**82.2**	**104**	**56.5 J**	**51.4 J**	**42.2 J**	**47.4 J**	- -	**150**	**131**	**157 J**	**134 J**	**107 J**	**118 J**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	**0.4 J**	**0.4 J**	5 U	5 U	- -	0.64 U	0.4 U	**0.3 J**	**0.3 J**	5 U	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**64000**	- -	**64100**	**60800**	- -	- -	- -	**57700**	- -	**60000**	**49700**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	6.6 U	**12.7**	**3.9 J**	**1 J**	**0.88 J**	**1.7 J**	- -	12 U	1.8 U	**3.5 J**	**2.1 J**	10 U	10 U	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**1.9**	**2.3 J**	10 U	10 U	10 U	10 U	- -	**1.4**	**3.2 J**	**2.1 J**	**2.3 J**	10 U	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**26600**	- -	**25100**	**25100**	- -	- -	- -	**25200**	- -	**24700**	**21300**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	**2.8 J**	**2 J**	**2.1 J**	10 U	10 U	- -	2.9 U	**8.4**	**5.2 J**	**7.4 J**	**7.3 J**	10 U	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	10 U	10 U	10 U	10 U	- -	1.1 U	2.8 U	10 U	10 U	10 U	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**11800**	- -	**10000**	**9900**	- -	- -	- -	**13200**	- -	**12000**	**13500**	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.64 U	1.3 U	0.55 U	1.1 U	- -	0.02 U	0.16 U	1.2 U	0.83 U	0.91 U	0.34 U	0.19 U	0.19 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 U	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.5 U	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

					Location	12-C											12-D					
					Sample ID	H12C-010800	12C-052100	12-C-20001114	12-C-20010518	12-C-20020605	12-C-20030515	F05-12-C-GW-REG	S06-12-C-GW-REG	F06-12-C-GW-REG	S07-12-C-GW-REG	L2-12-C-0818	H12D-010900	12D-052100	12-D-20001114	12-D-20010521	12-D-20020604	12-D-20030516
					Sample Depth (ft)	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	40.2 - 50.2	120 - 130	120 - 130	120 - 130	120 - 130	120 - 130	120 - 130
					Sample Date	1/8/2000	5/21/2000	11/14/2000	5/18/2001	6/5/2002	5/15/2003	10/5/2005	4/12/2006	8/31/2006	6/5/2007	8/29/2018	1/9/2000	5/21/2000	11/14/2000	5/21/2001	6/4/2002	5/16/2003
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**																	
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**485000**	- -	**480000**	**480000**	**480000**	**500000**	- -	- -	- -	- -	- -	**454000**	- -	**440000**	**580000**	**450000**	**470000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**4100**	- -	**4000**	**4000**	**4000**	**3600**	- -	- -	- -	- -	- -	**2900**	- -	**1800**	**3000**	**2600**	**2700**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**434000**	- -	**42000**	**60000**	**210000**	**24000**	- -	- -	- -	- -	- -	**401000**	- -	**50000**	**110000**	**200000**	**75000**
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	950 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	***260***	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	1000 U	1000 U	**24000**	1000 U	- -	- -	- -	- -	- -	200 U	- -	1000 U	1000 U	**23000**	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	2600 U	- -	**4100**	**4800**	**7400 J**	**5700**	- -	- -	- -	- -	- -	**2400**	- -	**2900**	**3400**	**3000**	**3500**
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**9800**	- -	**7500**	**7000**	**6800**	**6500**	- -	- -	- -	- -	- -	620 U	- -	**3500**	**2800**	**3200**	**2800**
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**1300**	- -	1000 U	**1000**	1000 U	**1000**	- -	- -	- -	- -	- -	**1500**	- -	1000 U	**1000**	**1000**	**1000**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	10 U	10 U	10 U	50 U	- -	- -	- -	- -	- -	50 U	- -	10 U	**40**	**40**	50 U
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**7600**	- -	**8400**	**7000**	**2000**	**2000**	- -	- -	- -	- -	- -	**2200**	- -	**2400**	**3000**	**2000**	1000 U
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.03 U	0.2 U	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.9 U	0.58 U	0.81 U	0.75 U	- -	- -	- -	- -	0.1 U	- -	- -	1.3 U	0.6 U	0.73 U	0.3 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.11 U	0.2 U	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.05 U	0.2 U	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.05 U	0.4 U	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.03 U	0.4 U	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.2 U	0.07 U	0.4 U	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.27 U	0.31 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.02 U	0.4 U	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.2 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.1 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.06 U	**0.62**	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.06 U	0.2 U	1.3 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.28 U	0.16 U	0.84 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	0.1 U	0.05 U	**1.1**	1.2 U	0.48 U	0.58 U	0.3 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	***43.5***	***39.8***	***77.5***	***88***	***43.7***	***36.4***	***41.4***	***31.6***	***43***	- -	- -	2.7 U	**3.5 J**	10 U	10 U	10 U	10 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	***20.7***	***31***	8.4 B	***33.1***	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**627**	**386**	**450**	**473**	**416 J**	**571**	- -	- -	- -	- -	- -	**224**	**212**	**220**	**999**	**213 J**	**213**
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	**0.3 J**	5 U	5 U	5 U	- -	- -	- -	- -	- -	0.64 U	0.4 U	10 U	5 U	5 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	**120000**	- -	**104000**	**104000**	- -	- -	- -	- -	- -	- -	- -	**93000**	- -	**87500**	**82900**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	***103***	**6.3 J**	**2.8 J**	**2.1 J**	**0.8 J**	**25.6**	- -	- -	- -	- -	- -	2.2 U	**6.9 J**	**8.1 J**	**3.6 J**	**11.6**	10 U
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**12.9**	**2.7 J**	10 U	**1.2 J**	10 U	10.7 U	- -	- -	- -	- -	- -	1.4 U	**2.6 J**	**2.2 J**	**1.2 J**	10 U	**3.1 J**
METALS	7439-95-4	Magnesium	µg/L	--	45243	**43700**	- -	**36900**	**37100**	- -	- -	- -	- -	- -	- -	- -	**42000**	- -	**38700**	**36600**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	**0.06**	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	- -	- -	- -	- -	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U
METALS	7782-49-2	Selenium	µg/L	50	10	4.9 U	2.6 U	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	**2.91**	**3.5 J**	10 U	10 U	10 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	1.1 U	2.8 U	10 U	10 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	**39400**	- -	**34400**	**36000**	- -	- -	- -	- -	- -	- -	- -	**36800**	- -	**34600**	**59700**	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.9 U	0.47 U	0.65 U	0.75 U	- -	- -	- -	- -	- -	0.21 U	0.2 U	1.3 U	0.48 U	0.58 U	0.3 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

					Location	12-E						12-F											
					Sample ID	H12E-010800	12-E-050700	12-E-20001114	12-E-20010519	12-E-20020605	12-E-20030514	H12F-010600	12F-052000	12-F-20001116	12-F-20010520	12-F-20020614	12-F-20030515	F05-12-F-GW-FD	F05-12-F-GW-REG	S06-12-F-GW-REG	F06-12-F-GW-REG	S07-12-F-GW-REG	L2-12-F-0818
					Sample Depth (ft)	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4	40.4 - 50.4
					Sample Date	1/8/2000	5/7/2000	11/14/2000	5/19/2001	6/5/2002	5/14/2003	1/6/2000	5/20/2000	11/16/2000	5/20/2001	6/14/2002	5/15/2003	10/3/2005	10/3/2005	4/12/2006	8/31/2006	6/5/2007	8/29/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**																		
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**257000**	- -	**250000**	**260000**	**280000**	**270000**	**498000**	- -	**480000**	**520000**	**560000**	**570000**	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	100 U	- -	10 U	10 U	10 U	20 U	**3800**	- -	**4100**	**4300**	**4500**	**3700**	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**240000**	- -	**38000**	**52000**	**120000**	**34000**	**448000**	- -	**42000**	**95000**	**250000**	**85000**	- -	- -	- -	- -	- -	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	270 U	- -	- -	- -	- -	- -	***170***	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	**4200**	1000 U	**26000**	1000 U	200 U	- -	1000 U	**1000**	1000 U	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	- -	300 U	**700**	300 U	**500**	**3500**	- -	**6320**	**5400**	**6700**	**6700**	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	**1300**	1000 U	1000 U	1000 U	620 U	- -	**8900**	**8600**	**8200**	**9200**	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2200**	- -	**1700**	**2000**	**1000**	**1000**	**1600**	- -	1000 U	**1000**	**1000**	**1000**	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	910 U	- -	**680**	**550**	**490**	**550**	50 U	- -	50 U	**40**	10 U	50 U	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**18700**	- -	**33000**	**19000**	**19000**	**20000**	**31300**	- -	**22000**	**17000**	**14000**	**11000**	- -	- -	- -	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.86 U	0.77 U	0.53 U	0.53 U	0.03 U	0.22 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.86 U	0.96 U	0.66 U	0.53 U	- -	- -	0.9 U	1.3 U	0.66 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.86 U	0.77 U	0.53 U	0.53 U	0.04 U	0.22 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.86 U	0.77 U	0.53 U	0.53 U	0.05 U	0.22 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.86 U	0.77 U	0.53 U	0.53 U	0.05 U	0.44 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	0.86 U	0.77 U	0.53 U	0.53 U	0.06 U	0.44 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.86 U	0.77 U	0.53 U	0.53 U	0.06 U	0.44 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.12 U	0.31 U	0.86 U	0.77 U	0.53 U	0.53 U	0.38 U	0.44 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	0.86 U	0.77 U	0.53 U	0.53 U	0.06 U	0.5 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.86 U	0.77 U	0.53 U	0.53 U	0.06 U	0.22 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.05 U	0.16 U	0.81 U	0.77 U	0.53 U	0.53 U	0.58 U	0.22 U	0.84 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	2.4 U	10 U	10 U	10 U	10 U	***17.4***	***17.5***	**8.5 J**	***10.3***	***14.1***	***19.2***	**10**	***13.1***	***85.8***	***44.9***	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	6.9 B	2.9 U	2.9 U	8.3 B	9.7 B	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**72.9**	**60.4**	**67.6 J**	**73.1 J**	**83.6 J**	**70.6 J**	**750**	**702**	**625**	**1370**	**600 J**	**635**	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	**0.3 J**	**0.4 J**	5 U	5 U	0.64 U	0.4 U	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**63300**	- -	**65700**	**62000**	- -	- -	**131000**	- -	**112000**	**113000**	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**43.6**	1.8 U	**1.6 J**	**1 J**	10 U	**0.55 J**	**56.5**	**48.7**	**1.3 J**	**2.4 J**	**1.8 J**	**13**	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	1.4 U	1.7 U	**2.9 J**	10 U	10 U	10 U	***17.2***	**9.8**	**2.6 J**	**1.5 J**	10 U	10 U	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**28400**	- -	**27600**	**27400**	- -	- -	**54000**	- -	**43200**	**43600**	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	**0.06**	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	3.1 U	2.6 U	10 U	10 U	**2.9 J**	10 U	**3.3**	**5**	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	10 U	10 U	10 U	10 U	1.1 U	2.8 U	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**9400**	- -	**6730**	**6750**	- -	- -	**50100**	- -	**47000**	**56500**	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.76 U	0.16 U	0.86 U	0.77 U	0.53 U	0.53 U	0.02 U	0.22 U	0.9 U	1 U	0.53 U	0.95 U	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[(1)])	H12G-010800	12G-052000	12-G-20001115	12-G-20010520	12-G-20020605	12-G-20030516	G15-010400	G-15-052200	G-15-20001116	G-15-20010520	G-15-20020617	G-15-20030518	F04-GW-053	G-15-1	G-15-BL	G-15-5	G-15-2	G-15-2-FD	S08-G-15-GW-REG	CONTG-FD1	G15-0418
					Location	12-G						G-15														
					Sample Depth (ft)	10.3 - 20.3	10.3 - 20.3	10.3 - 20.3	10.3 - 20.3	10.3 - 20.3	10.3 - 20.3	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5
					Sample Date	1/8/2000	5/20/2000	11/15/2000	5/20/2001	6/5/2002	5/16/2003	1/4/2000	5/22/2000	11/16/2000	5/20/2001	6/17/2002	5/18/2003	11/16/2004	6/29/2006	7/13/2006	7/27/2006	6/29/2007	6/29/2007	5/8/2008	4/22/2018	4/22/2018
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	331000	--	320000	310000	320000	330000	111000	--	140000	110000	140000	150000	190000	--	--	--	--	--	--	--	--
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	150	--	10 U	10 U	10 U	20 U	100 U	--	90	10 U	60	20 U	--	--	--	--	--	--	--	--	--
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	297000	--	24000	57000	140000	28000	126000	--	50000	62000	62000	40000	6400	--	--	--	--	--	--	--	--
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	97	--	--	--	--	--	330	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	--	1400	1000 U	22000	1000 U	200 U	--	3900	1000 U	1000 U	1000 U	--	--	--	--	--	--	--	--	--
GENERAL	TDS	Total dissolved solids	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	303000	302000	276000	382000	344000	--	--	--
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	--	400	700	300 U	300 U	100 U	--	400	600	300 U	300 U	--	--	--	--	--	--	--	--	--
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	--	1000	1000 U	1000	1000 U	620 U	--	2300	2100	2600	2300	2200	--	--	--	--	--	--	--	--
GENERAL	TSS	Total suspended solids	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5000 B	4000 U	4000 B	25000	18000	--	--	--
ANIONS	16887-00-6	Chloride	µg/L	--	--	4400	--	6700	4000	3000	4000	88600	--	85000	13000	29000	25000	20000	--	--	--	--	--	--	--	--
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	--	--	--	--	--	--	--	--	--	--	--	--	200 U	--	--	--	--	--	--	--	--
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	--	320	470	360	390	50 U	--	30 U	1300	150	910	--	--	--	--	--	--	--	--	--
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	--	--	--	--	--	--	--	--	--	--	--	--	100 U	--	--	--	--	--	--	--	--
ANIONS	14808-79-8	Sulfate	µg/L	--	--	69400	--	84000	72000	69000	72000	25800	--	42600	22000	20000	23000	23000	--	--	--	--	--	--	--	--
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BACTERIA	ARCHEA	Archea	cells/mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.64 U	0.51 U	1.6 U	1 U	0.03 U	0.22 U	0.56 U	0.23 U	1.1 U	0.2 U	0.53 U	0.2 U	0.23 U	0.2 U	0.2 U	0.2 U	--	0.41 U	0.42 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	--	--	0.64 U	0.63 U	1.9 U	1 U	--	--	4.1	20	25	54	40	--	--	--	--	--	--	--	--
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.64 U	0.51 U	1.6 U	1 U	0.04 U	0.22 U	0.56 U	0.23 U	1.1 U	0.2 U	0.53 U	0.2 U	0.23 U	0.2 U	0.2 U	0.2 U	--	0.21 U	0.21 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.64 U	0.51 U	1.6 U	1 U	0.05 U	0.22 U	0.56 U	0.23 U	1.1 U	0.2 U	0.53 U	0.2 U	0.23 U	0.2 U	0.2 U	0.2 U	--	0.21 UJ	0.21 UJ
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.64 U	0.51 U	1.6 U	1 U	0.05 U	0.44 U	0.56 U	0.23 U	1.1 U	0.2 U	0.53 U	0.2 U	0.23 U	0.2 U	0.2 U	0.2 U	--	0.21 UJ	0.21 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	0.64 U	0.51 U	1.6 U	1 U	3.2	3.2 J	2.7	1.4	1.8 J	1.1	2.6	1.7	1.3	1.7	1.4	1.3	--	0.18 J	0.18 J
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, disso	µg/L	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.7	1.4	0.96	1.1	1.1	--	--	--
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.38 U	0.31 U	0.64 U	0.51 U	1.6 U	1 U	0.06 U	0.44 U	0.56 U	0.23 U	1.1 U	0.18 J	0.53 U	0.2 U	0.23 U	0.2 U	0.2 U	0.2 U	--	0.21 UJ	0.21 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.14 U	0.31 U	0.64 U	0.51 U	1.6 U	1 U	3.1 U	3.43	3.2	1.8	2.3	1.3	3.6	2.3	1.8	2.3	1.9	1.7	--	0.25 J	0.23 J
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, disso	µg/L	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.3	2.1	1.4	1.5	1.5	--	--	--
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.1	--	--	--	--	--	--	--	--
EXPLOSIVES	DNX	DNX	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.7 P	--	--	--	--	--	--	--	--
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.2 U	0.39 U	0.64 U	0.51 U	1.6 U	1 U	190	170 J	110	190	300 J	380	370 D	180	131	130	306	305	--	250	240
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	187	159	94.3	262	284	--	--	--
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.64 U	0.51 U	1.6 U	1 U	1.1 U	0.22 U	0.56 U	0.23 U	1.1 U	0.2 U	0.53 U	0.2 U	0.23 U	0.2 U	0.2 U	0.2 U	--	0.21 UJ	0.21 UJ
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.1 U	0.16 U	0.6 U	0.51 U	1.6 U	1 U	72	120 J	48	250	430	940	650 D	133	68.1	40.6	292	305	--	590	560
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	149	81.7	24	254	306	--	--	--
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	4 J	10 U	10 U	10 U	10 U	4.6	6.4 J	10 U	10 U	10 U	10 U	20 U	--	--	--	--	--	--	--	--
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
METALS	7440-39-3	Barium	µg/L	2000	430	149	125	130 J	111 J	103 J	94.9 J	191	141	172 J	99.3 J	87.2 J	104 J	126 B	--	--	--	--	--	--	--	--
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	5 U	0.3 J	5 U	5 U	0.7	0.4 J	0.5 J	0.4 J	5 U	5 U	0.49 B	--	--	--	--	--	--	--	--
METALS	7440-70-2	Calcium	µg/L	--	119033	99300	--	88800	87800	--	--	66000	--	60900	43800	--	--	56500	--	--	--	--	--	--	--	--
METALS	7440-47-3	Chromium	µg/L	100	31	11.9	20.3	8.7 J	2.5 J	2.5 J	10 U	11.7 U	5.7 J	2.8 J	0.8 J	10 U	3.4 J	0.79 B	--	--	--	--	--	--	--	--
METALS	7439-89-6	Iron	µg/L	14000	9736	--	--	--	--	--	--	--	--	--	--	--	--	63.4 B	--	--	--	--	--	--	--	--
METALS	7439-92-1	Lead	µg/L	15	18.05	1.4 U	2.1 J	10 U	10 U	10 U	10 U	2.5 U	3.6 J	1.7 J	1.2 J	10 U	3.5 J	3.6 B	--	--	--	--	--	--	--	--
METALS	7439-95-4	Magnesium	µg/L	--	45243	41900	--	38000	38700	--	--	18800	--	17000	11700	--	--	15200	--	--	--	--	--	--	--	--
METALS	7439-96-5	Manganese	µg/L	430	580	--	--	--	--	--	--	--	--	--	--	--	--	35 E	--	--	--	--	--	--	--	--
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	0.2 U	--	--	--	--	--	--	--	--
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	1.4 J	2 J	10 U	10 U	2.9 U	2.6 U	10 U	2.5 J	2 J	10 U	10 U	--	--	--	--	--	--	--	--
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	10 U	10 U	10 U	10 U	4.8 U	2.8 U	10 U	10 U	10 U	10 U	10 U	--	--	--	--	--	--	--	--
METALS	7440-23-5	Sodium	µg/L	--	42581	15200	--	12500	14100	--	--	21100	--	22600	8730	--	--	11500 E	--	--	--	--	--	--	--	--
METALS	7440-66-6	Zinc	µg/L	6000	789	--	--	--	--	--	--	--	--	--	--	--	--	50	--	--	--	--	--	--	--	--
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.64 U	0.51 U	1.6 U	1 U	0.02 U	0.22 U	0.56 U	0.23 U	1.1 U	0.2 U	0.53 U	0.2 U	0.23 U	0.2 U	0.2 U	0.2 U	--	--	--
VOLATILES	74-85-1	Ethene	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VOLATILES	74828	Methane	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	58	--	--	--	--	--	--	--	--

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-70											
					Sample ID	JAW-70-052000	JAW-70-20001114	JAW-70-20010522	JAW-70-20010522-FD	JAW-70-20020604	JAW-70-20020604-FD	JAW-70-20030516	F04-GW-052	F05-JAW-70-GW-REG	S06-JAW-70-GW-REG	JAW-70-F01R6	JAW70-0818
					Sample Depth (ft)	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17
					Sample Date	5/20/2000	11/14/2000	5/22/2001	5/22/2001	6/4/2002	6/4/2002	5/16/2003	11/16/2004	9/30/2005	4/13/2006	9/26/2008	8/28/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**												
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**130000**	**280000**	**280000**	**270000**	**270000**	**280000**	**270000**	**251000**	**263000**	**224000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	10 U	10 U	10 U	10 U	**20**	20 U	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**14000**	**26000**	**21000**	**118000**	**118000**	**28000**	**6500**	**256000**	**414000**	**240000**	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	**2200**	1000 U	1000 U	**24000**	**24000**	1000 U	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	300 U	300 U	300 U	300 U	300 U	**400**	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	**2600**	**1300**	**1200**	**1300**	**1400**	**1400**	**1100**	**1600**	**1100**	**1300**	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	**2300**	**2000**	**3000**	**2000**	**2000**	**2000**	**2000**	1000 U	**6900**	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	200 U	**260**	**330**	**2400**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	**380**	**190**	**200**	**210**	**230**	**280**	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	100 U	50 U	50 U	50 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	**17000**	**15000**	**16000**	**15000**	**15000**	**16000**	**13000**	**10200**	**16800**	**15700**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.17 U	1 U	0.36 U	0.46 U	0.49 U	1.2 U	1.1 U	0.49 U	0.2 U	0.19 U	**0.18 J**	**0.19 J**
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	**22**	**10**	**10**	**6 J**	**5.3 J**	**5.9 J**	**5.8**	**4.5**	**4.1**	**3**	**3.3 J**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	**0.34 J**	**0.73 J**	0.36 U	0.46 U	0.49 U	1.2 U	1.1 U	0.49 U	0.2 U	0.19 U	0.19 U	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.17 U	1 U	0.36 U	0.46 U	0.49 U	1.2 U	1.1 U	**0.2 J**	**0.22**	**0.13 J**	**0.22**	0.1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.34 U	1 U	0.36 U	0.46 U	0.49 U	1.2 U	1.1 U	0.49 U	0.2 U	0.19 U	0.19 U	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***27 J***	***68***	***54***	***54***	***53 J***	***42 J***	***51***	***55 D***	***58.7***	***30.9***	***39.5***	***7.4 J***
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, disso	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.34 U	1 U	0.36 U	0.46 U	0.49 U	1.2 U	1.1 U	0.49 U	0.2 U	0.19 U	0.19 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.34 U	***46***	***33***	***34***	***22 J***	***29 J***	***28***	***27***	***26.5***	***17.3***	***17.7***	***7.3 J***
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, disso	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	**4.8**	**4**	**2.1**	**1.1**	**1.7 J**
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	**1.8 P**	**0.74**	**0.77**	**0.51**	**16 J**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**430 J**	**460**	**330**	**420**	**440 J**	**420 J**	**440**	**450 D**	**444**	**287**	**331**	**160 J**
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.17 U	1 U	0.36 U	0.46 U	0.49 U	1.2 U	1.1 U	0.49 U	0.2 U	0.19 U	0.19 U	***14 J***
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***880 J***	***970***	***570***	***690***	***600***	***610***	***480***	***370 D***	***308***	***260***	***180***	***180 J***
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	**2.8 J**	10 U	10 U	10 U	10 U	10 U	10 U	20 U	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**85.3**	**83.3 J**	**81 J**	**83.2**	**81.7 J**	**81.8 J**	**81.3 J**	86.9 B	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	5 U	5 U	5 U	5 U	5 U	5 U	0.72 B	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**61600**	**58100**	**59900**	- -	- -	- -	**59800**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	1.8 U	10 U	10 U	10 U	10 U	10 U	10 U	0.82 B	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	36.8 B	- -	- -	61.3 B	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**2.3 J**	**2.2 J**	10 U	10 U	10 U	10 U	10 U	4.1 B	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**27500**	**27600**	**28200**	- -	- -	- -	**26700**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	12.1 BE	- -	- -	4.8 B	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	0.21 U	0.21 U	0.21 U	0.2 U	0.2 U	0.2 U	0.2 U	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	10 U	**0.5 J**	10 U	10 U	10 U	10 U	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**8790**	**8640**	**8970**	- -	- -	- -	**8240 E**	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	35.8 B	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.17 U	1 U	0.36 U	0.46 U	0.49 U	1.2 U	1.1 U	0.49 U	0.2 U	0.19 U	0.19 U	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1 U	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	**1.6**	0.5 U	- -	**1.34**	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-71								JAW-72							
					Sample ID	JAW-71-052000	JAW-71-20001115	JAW-71-20010523	JAW-71-20020604	JAW-71-20030516	F05-JAW-71-GW-REG	S06-JAW-71-GW-REG	JAW-71-0818	JAW-72-052000	JAW-72-20001114	JAW-72-20010523	JAW-72-20020604	JAW-72-20030516	F04-GW-051	F05-JAW-72-GW-REG	S06-JAW-72-GW-REG
					Sample Depth (ft)	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20
					Sample Date	5/20/2000	11/15/2000	5/23/2001	6/4/2002	5/16/2003	10/3/2005	4/12/2006	8/28/2018	5/20/2000	11/14/2000	5/23/2001	6/4/2002	5/16/2003	11/16/2004	9/30/2005	4/12/2006
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95(1))																
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	260000	260000	270000	270000	376000	293000	- -	- -	220000	240000	240000	250000	230000	336000	225000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	10 U	10 U	10 U	50	- -	- -	- -	- -	10 U	10 U	40	20 U	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	28000	44000	120000	31000	442000	419000	- -	- -	37000	46000	110000	34000	6300	349000	314000
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	1000 U	23000	6000	- -	- -	- -	- -	1000 U	1000 U	24000	1000 U	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	400 U	500	300 U	400	- -	- -	- -	- -	500 U	300 U	500	300 U	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	1500	1000 U	1200	1000 U	1400	1000	- -	- -	1600	1200	1400	1200	1200	1700	1200
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	2000	2000	2000	1000 U	6600	- -	- -	2100	3000	3000	2000	3000	1000 U	8100
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	50 U	90 B	- -	- -	- -	- -	- -	- -	700	1000	600
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	20	20 U	30	50 U	- -	- -	- -	- -	890	930	780	670	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	50 U	50 U	- -	- -	- -	- -	- -	- -	100 U	50 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	40000	40000	37000	52500	32300	- -	- -	100000	29000	29000	31000	28000	23600	25300
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.16 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	0.1 UJ	0.18 U	0.42 J	1.3 U	0.53 J	0.47 U	0.7 P	0.2 U	0.2 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	2	1.7 J	1.3 J	1 J	0.6	0.89	0.31 J	- -	39	25	16 J	14 J	16	16.6	10.6
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.16 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	0.1 UJ	0.18 U	2.5	1.3 U	0.53 U	0.47 U	0.5 U	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.16 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	0.1 UJ	0.18 U	3.3	1.3 U	3.2	1.7 J	2.6	4.1	0.51
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.31 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	0.1 UJ	0.35 U	0.86 U	1.3 U	0.53 U	0.47 U	0.66	0.78	0.24
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.31 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	0.1 UJ	64 J	66	56	58 J	62	60 D	67.7	32.8
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, diss(	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.31 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	0.2 UJ	0.35 U	0.86 U	1.3 U	0.53 U	0.47 U	0.5 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.31 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	0.1 UJ	35 J	39	35	34 J	28	34	38.9 J	22.5
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, diss(	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	1.2	1	0.24 J	- -	- -	- -	- -	- -	5.1	6.8	3.3
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	0.23	0.27	2.1 J	- -	- -	- -	- -	- -	5:00 PM	6.3	3.1
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	8.1 J	12	9.8	12 J	7.8	10.5	10.1	4.9 J	320 J	310	280	290 J	350	340 D	356	222
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.16 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	0.1 UJ	0.18 U	0.86 U	1.3 U	0.53 U	0.47 U	0.5 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	17 J	15	9.5	9.8	7.1 J	5.3	8.5	2.4 J	2400 J	2300	2000	2300	2000	2200 D	2140	1110
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	3.3 J	10 U	10 U	10 U	10 U	- -	- -	- -	2.4 U	10 U	10 U	10 U	10 U	20 U	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	90.3	98.6 J	81.9 J	79.8 J	86.7 J	- -	- -	- -	79.1	84 J	87.8 J	69.6 J	78.1 J	87.3 B	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	5 U	5 U	5 U	5 U	- -	- -	- -	0.4 U	5 U	5 U	5 U	5 U	0.71 B	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	69000	61500	- -	- -	- -	- -	- -	- -	56300	56500	- -	- -	57600	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	1.8 U	0.4 J	10 U	10 U	10 U	- -	- -	- -	1.8 U	10 U	10 U	10 U	10 U	0.95 B	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	20.6 B	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	2.2 J	10 U	10 U	10 U	10 U	- -	- -	- -	2.5 J	10 U	10 U	10 U	10 U	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	26500	23200	- -	- -	- -	- -	- -	- -	25300	25800	- -	- -	25500	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	39.6 E	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	- -	- -	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	0.2 U	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	1.8 J	10 U	10 U	10 U	- -	- -	- -	2.6 U	1.4 J	1.7 J	10 U	10 U	10 U	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	10 U	0.4 J	10 U	10 U	- -	- -	- -	2.8 U	10 U	0.5 J	10 U	10 U	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	22800	22000	- -	- -	- -	- -	- -	- -	10000	10400	- -	- -	10600 E	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	28.8 B	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.16 U	0.74 U	0.62 U	1.5 U	0.55 U	0.19 U	0.2 U	- -	0.39 J	0.83 J	1.3 U	0.32 J	0.47 U	0.27 J	0.33	0.063 J
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	1 U	- -	- -	- -	- -	- -	- -	- -	- -	1 U	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	0.5 U	- -	- -	- -	- -	- -	- -	- -	0.87 U	0.5 U	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-72											JAW-73				
					Sample ID	JAW-72-F01R1	JAW-72-F01R2	JAW-72-F01R2-FD	JAW-72-F01R3	JAW-72-F01R4	JAW-72-F01R5	JAW-72-F01R6	JAW-72-F01R6-FD	JAW-72-01R7	JAW-72-F01R7	JAW-72-F01R8	JAW-73-050700	JAW-73-20001115	JAW-73-20010523	JAW-73-20020604	JAW-73-20030516
					Sample Depth (ft)	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20
					Sample Date	11/12/2007	1/3/2008	1/3/2008	2/8/2008	3/14/2008	6/1/2008	9/26/2008	9/26/2008	3/10/2009	3/13/2009	6/26/2009	5/7/2000	11/15/2000	5/23/2001	6/4/2002	5/16/2003
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**																
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**600000**	**442000**	**667000**	**420000**	**450000**	**600000**	**573000**	**504000**	**6900**	- -	**487000**	- -	**220000**	**220000**	**220000**	**240000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	10 U	10 U	10 U	20 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**6540000**	**875000**	**1260000**	**842000**	**951000**	**1040000**	**1030000**	**854000**	**544000**	- -	**528000**	- -	**29000**	**42000**	**97000**	**36000**
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**5400**	1000 U	**26000**	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	300 U	300 U	300 U	**400**
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1870000**	**151000**	**149000**	**194000**	**344000**	**307000**	**218000**	**229000**	**35100**	- -	**20700**	- -	**1300**	1000 U	1000 U	1000 U
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**58000**	**36000**	**49000**	**46000**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**1000**	**320**	50 U	50 U	50 U	50 U	**220**	**230**	**140**	- -	**130**	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**1700**	**950**	**310**	**310**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	***1500***	50 U	50 U	50 U	50 U	***2900***	100 U	100 U	70 B	- -	50 U	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**25400**	**13100**	**14800**	**17100**	**18200**	**21300**	**12200**	**12300**	**7400**	- -	**5500**	- -	**180000**	**130000**	**150000**	**160000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**10700000**	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**2170000**	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**9780000**	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**435000**	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.16 U	0.58 U	0.68 U	1.3 U	0.92 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**14.2**	**1.8**	**1.9**	**0.43**	**0.67**	**1.7**	**2.7**	**2**	2.9 U	- -	**5.2**	- -	**2.8**	**3.2 J**	**2.2**	**2 J**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.16 U	0.58 U	0.68 U	1.3 U	0.92 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	**0.11 J**	0.16 U	0.58 U	0.68 U	1.3 U	0.92 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.31 U	0.58 U	0.68 U	1.3 U	0.92 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	**0.25**	**0.28**	**0.32**	**0.33**	**1.6**	**0.28**	**0.18 J**	**1.2**	- -	***2***	0.31 U	0.58 U	0.68 U	1.3 U	0.92 U
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, disso	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.31 U	0.58 U	0.68 U	1.3 U	0.92 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**1.2**	**0.41**	**0.45**	**0.34**	**0.36**	**1.2**	**0.5**	**0.3**	**0.62**	- -	**1.2**	0.31 U	**0.34 J**	0.68 U	1.3 U	0.92 U
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, disso	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**5.8**	**6.2**	**5.7**	**6.7**	**2.3**	0.78 U	**2.8**	**2.3**	1.9 U	- -	1.5 U	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	**7.8**	**0.36**	**0.37**	**0.11 J**	0.38 U	0.19 U	**0.29**	**0.2**	0.76 U	- -	**1.3**	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**115**	**31.3**	**28.9**	**7.8**	**7.4**	**29.1**	**22**	**15.5**	**29**	- -	**38.6**	**12**	**7.4**	**8**	**8.6**	**9.2**
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.16 U	0.58 U	0.68 U	1.3 U	0.92 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***218***	***55***	***56.8***	***20.1***	***25.4***	***63.3***	***26.7***	***19.3***	***50.7***	- -	***97***	***40***	***37***	***32***	***33***	***30***
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.4 U	10 U	10 U	**4.9 J**	10 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**96.1**	**125 J**	**115 J**	**102 J**	**114 J**
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.4 U	**0.3 J**	5 U	5 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**101000**	**91700**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.8 U	**0.5 J**	10 U	10 U	10 U
METALS	7439-89-6	Iron	µg/L	14000	9736	***35100***	***34900***	***34900***	***40200***	***49000***	***69200***	***56800***	***56700***	***23000***	- -	***15000***	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.7 U	**1.8 J**	10 U	10 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**45600**	**43000**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	***73400***	***12000***	***11800***	***9440***	***8300***	***5940***	***3860***	***3830***	***2500***	- -	***2440***	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.6 U	10 U	10 U	**3.7 J**	10 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.8 U	10 U	10 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**16100**	- -	**16000**	**16500**	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.16 U	0.58 U	0.68 U	1.3 U	0.92 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**2.94**	**2.04**	**1.8**	**2.28**	**4.43**	**545**	**11700**	**12000**	**13400**	- -	**14500**	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-73											JAW-74					
					Sample ID	JAW-73-20030516-FD	F05-JAW-73-GW-REG	S06-JAW-73-GW-REG	JAW-73-F01R1	JAW-73-F01R2	JAW-73-F01R3	JAW-73-F01R4	JAW-73-F01R5	JAW-73-F01R6	JAW-73-F01R8	JAW-73-0818	JAW-74-050700	JAW-74-20001114	JAW-74-20010522	JAW-74-20020605	JAW-74-20030515	L2-JAW-74-0818
					Sample Depth (ft)	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	12 - 22	12 - 22	12 - 22	12 - 22	12 - 22	12 - 22
					Sample Date	5/16/2003	10/3/2005	4/12/2006	11/12/2007	1/4/2008	2/8/2008	3/14/2008	6/1/2008	9/26/2008	6/26/2009	8/29/2018	5/7/2000	11/14/2000	5/22/2001	6/5/2002	5/15/2003	8/29/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**																	
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**240000**	**232000**	**121000**	**255000**	**230000**	**240000**	**350000**	**280000**	**203000**	**1300000**	- -	- -	**160000**	**140000**	**160000**	**220000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	20 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	10 U	10 U	10 U	20 U	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**36000**	**252000**	**141000**	**669000**	**246000**	**258000**	**600000**	**329000**	**231000**	**3070000**	- -	- -	**130000**	**150000**	**70000**	**110000**	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	**3000**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**2900**	1000 U	**26000**	1000 U	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	300 U	300 U	300 U	**400**	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	690 B	660 B	**16300**	**26000**	**28100**	**45000**	980 B	740 B	**1100000**	- -	- -	1000 U	1000 U	1000 U	1000 U	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**44000**	**19800**	**19000**	- -	- -	- -	- -	- -	- -	- -	- -	- -	**48000**	**56000**	**54000**	**70000**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	**180**	**490**	**1500**	**1200**	**1100**	**1000**	**650**	**660**	50 U	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**310**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**610**	**640**	**560**	**550**	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	50 U	50 U	***2400***	50 U	50 U	50 U	50 U	50 U	100 U	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**150000**	**118000**	**99100**	**96600**	**98300**	**96200**	**93000**	**90600**	**79600**	**2200**	- -	- -	**28000**	**29000**	**25000**	**29000**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.1 U	0.19 U	0.21 U	0.2 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.11 U	0.17 U	0.47 U	0.42 U	0.39 U	1.1 U	0.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**2.2**	**3.2**	**3.1**	**4.5**	**3.5**	**3.7**	**3.5**	**3.6**	**3**	0.19 U	0.11 U	- -	0.47 U	0.52 U	0.49 U	1.1 U	0.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.1 U	0.19 U	0.21 U	0.2 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.11 U	0.17 U	0.47 U	0.42 U	0.39 U	1.1 U	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.1 U	0.19 U	0.21 U	0.2 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.11 U	0.17 U	0.47 U	0.42 U	0.39 U	1.1 U	0.1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.1 U	0.19 U	0.21 U	0.2 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.11 U	0.34 U	0.47 U	0.42 U	0.39 U	1.1 U	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.1 U	0.19 U	0.21 U	0.2 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	**0.15 J**	0.11 U	0.34 U	0.47 U	0.42 U	0.39 U	1.1 U	0.1 U
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, disso	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	1.1 U	0.19 U	0.21 U	0.2 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.76 U	0.21 U	0.34 U	0.47 U	0.42 U	0.39 U	1.1 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.1 U	**0.16 J**	**0.21**	**0.46**	**0.31**	**0.3**	**0.3**	**0.31**	**0.45**	0.19 U	0.11 U	0.34 U	0.47 U	0.42 U	0.39 U	1.1 U	0.1 U
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, disso	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	**2.6**	**2.2**	**1.7**	**1.4**	**1.7**	**1.5**	**1.1**	**1.2**	0.19 U	0.21 U	- -	- -	- -	- -	- -	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	**1**	**1.1**	**1.1**	**0.96**	**1**	**0.82**	**0.79**	**0.74**	0.19 U	0.11 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	9.6 U	**13.8**	**15.8**	**29.9**	**26**	**26.2**	**28**	**24.3**	**37.8**	0.19 U	0.11 U	0.42 U	0.47 U	0.42 U	0.39 U	1.1 U	**0.1 J**
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	1.1 U	0.19 U	0.21 U	0.2 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.11 U	0.17 U	0.47 U	0.42 U	0.39 U	1.1 U	0.1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	32 U	***54.6***	***56.6***	***83***	***78***	***74.4***	***71.5***	***64.1***	***69.1***	0.19 U	0.11 U	0.17 U	0.44 U	0.42 U	0.39 U	1.1 U	0.1 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.4 U	10 U	10 U	10 U	10 U	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**117**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**113**	**144 J**	**103 J**	**125 J**	**164 J**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.4 U	**0.4 J**	5 U	5 U	5 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**60100**	**47000**	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.8 U	**0.7 J**	10 U	10 U	10 U	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	15 U	15 U	15 U	15 U	23 U	23 U	***147000***	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.7 U	10 U	10 U	10 U	10 U	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**24000**	**20000**	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	1 U	1 U	2.3 B	1.8 B	1 U	1 U	***51500***	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.2 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**5.6**	**6.2 J**	**11**	**6.8 J**	**4.3 J**	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.8 U	10 U	10 U	10 U	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	**30400**	- -	- -	**14200**	**14400**	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	1.1 U	0.19 U	0.21 U	0.2 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	- -	0.17 U	0.47 U	0.42 U	0.39 U	1.1 U	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	0.5 U	- -	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.46 J**	**1460**	- -	- -	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-75					L2-DP01		L2-DP02		L2-DP03	L2-DP04	L2-DP05		L2-DP06	L2-DP07
					Sample ID	JAW-75-050700	JAW-75-20010522	JAW-75-20020604	JAW-75-20030515	L2-JAW-75-0818	L2-DP01-12	L2-DP01-39	L2-DP02-33	L2-DP02-23	L2-DP03-14	L2-DP04-37	L2-DP05-25	L2-DP05-54	L2-DP06-45	L2-DP07-27
					Sample Depth (ft)	7 - 17.5	7 - 17.5	7 - 17.5	7 - 17.5	7 - 17.5	8 - 12	34 - 39	29 - 33	18 - 23	10 - 14	33 - 37	21 - 25	49 - 54	40 - 45	23 - 27
					Sample Date	5/7/2000	5/22/2001	6/4/2002	5/15/2003	8/30/2018	11/21/2002	11/23/2002	10/28/2002	11/6/2002	11/11/2002	11/12/2002	10/28/2002	10/29/2002	11/5/2002	11/12/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**															
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**220000**	**220000**	**220000**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	10 U	**10**	20 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**32000**	**97000**	**22000**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	**20000**	1000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	300 U	300 U	**600**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	1000 U	1000 U	1200 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	**17000**	**16000**	**16000**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	**150**	**140**	**200**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	**49000**	**52000**	**48000**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.22 U	0.39 U	1.1 U	0.49 U	0.1 UJ	0.43 U	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.49 U	1.3 U	0.49 U	0.1 UJ	0.43 U	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.22 U	0.39 U	1.1 U	0.49 U	**0.26 J**	**0.68 P**	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.22 U	0.39 U	1.1 U	0.49 U	0.1 UJ	0.43 U	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.44 U	0.39 U	1.1 U	0.49 U	0.1 UJ	0.43 U	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.44 U	0.39 U	1.1 U	0.49 U	0.1 UJ	**0.46 P**	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.44 U	0.39 U	1.1 U	0.49 U	0.2 UJ	0.43 U	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.44 U	0.39 U	1.1 U	0.49 U	0.1 UJ	**0.5 P**	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	0.2 UJ	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	0.1 UJ	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.55 U	0.39 U	1.1 U	0.49 U	0.1 UJ	3.3 U	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.22 U	0.39 U	1.1 U	0.49 U	0.1 UJ	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.22 U	0.39 U	1.1 U	0.49 U	0.1 UJ	**1.2 P**	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.4 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**69.9**	**84.4 J**	**79.5 J**	**81.3 J**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**66300**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	1.8 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	1.7 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**25600**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	0.21 U	0.2 U	0.2 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	**2.7 J**	10 U	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**15900**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.22 U	0.39 U	1.1 U	0.49 U	- -	0.43 U	2.2 U	0.49 U	1.2 U	0.43 U	0.22 U	0.79 U	1.1 U	0.55 U	0.44 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

					Location	L2-DP08		L2-DP09		L2-DP10		L2-DP11			L2-DP12	L2-DP13	L2-DP14	L2-DP15		L2-DP16	
					Sample ID	L2-DP08-24	L2-DP08-57	L2-DP09-20	L2-DP09-56	L2-DP10-14	L2-DP10-45	L2-DP11-08	L2-DP11-55	L2-DP11-32	L2-DP12-52	L2-DP13-20	L2-DP14-23	L2-DP15-44	L2-DP15-17	L2-DP16-42	L2-DP16-20
					Sample Depth (ft)	19 - 24	52 - 57	15 - 20	51 - 56	10 - 14	40 - 45	4 - 8	51 - 55	27 - 32	47 - 52	15 - 20	18 - 23	40 - 44	12 - 17	38 - 42	15 - 20
					Sample Date	10/30/2002	10/30/2002	11/6/2002	11/13/2002	11/18/2002	11/19/2002	11/12/2002	11/12/2002	11/18/2002	11/6/2002	11/5/2002	11/18/2002	11/8/2002	11/9/2002	10/27/2002	11/5/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**																
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	0.26 U	0.31 U	0.53 U	0.33 U	0.77 U	0.25 U	- -	0.36 U	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.26 U	0.31 U	0.53 U	0.33 U	0.77 U	- -	**1.5**	**0.55**	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	0.26 U	0.31 U	0.53 U	0.33 U	0.77 U	0.25 U	- -	0.36 U	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	0.26 U	0.31 U	0.53 U	0.33 U	0.77 U	0.25 U	- -	0.36 U	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	- -	0.26 U	0.31 U	0.53 U	0.33 U	0.77 U	0.25 U	- -	0.36 U	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***3 P***	- -	0.31 U	0.53 U	0.33 U	0.77 U	- -	**0.48 P**	0.36 U	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	35572-78-2	ino-4,6-dinitrotoluene, diss	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	- -	0.26 U	0.31 U	0.53 U	0.33 U	0.77 U	0.25 U	- -	0.36 U	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***5.5 P***	- -	0.31 U	0.53 U	0.33 U	0.77 U	- -	**0.33 P**	0.36 U	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	19406-51-0	ino-2,6-dinitrotoluene, diss	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	0.26 U	0.31 U	0.53 U	0.33 U	0.77 U	- -	**8.8**	**6.1**	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***540 D***	- -	0.31 U	0.53 U	0.33 U	0.77 U	- -	***16 P***	***20***	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	0.46 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	- -	0.26 U	0.31 U	0.53 U	0.33 U	0.77 U	0.25 U	- -	0.36 U	0.4 U	0.43 U	0.51 U	0.25 U	0.66 U	0.4 U	**1.6**
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2

Iowa Army Ammunition Plant, Middletown, IA

					Location	L2-DP17		L2-DP18		L2-DP19		L2-DP20		L2-DP21	L2-DP22		L2-DP23	L2-DP24
					Sample ID	L2-DP17-10	L2-DP17-56	L2-DP18-12	L2-DP18-26	L2-DP19-51	L2-DP19-20	L2-DP20-61	L2-DP20-25	L2-DP21-49	L2-DP22-51	L2-DP22-10	L2-DP23-12	L2-DP24-06
					Sample Depth (ft)	6 - 10	52 - 56	8 - 12	21 - 26	47 - 51	15 - 20	57 - 61	20 - 25	44 - 49	47 - 51	5 - 10	8 - 12	2 - 6
					Sample Date	11/13/2002	11/18/2002	11/7/2002	11/9/2002	11/13/2002	11/19/2002	11/12/2002	11/19/2002	10/30/2002	11/19/2002	11/20/2002	11/22/2002	11/22/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**													
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.69 U	0.49 U	0.3 U	0.38 U	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**8**	0.49 U	0.3 U	0.38 UJ	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.69 U	0.49 U	0.3 U	0.38 UJ	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.69 U	0.49 U	0.3 U	0.38 U	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.69 U	0.49 U	0.3 U	0.38 U	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***7 P***	0.49 U	0.3 U	0.38 UJ	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, diss	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.69 U	0.49 U	0.3 U	0.38 U	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***4.6 P***	0.49 U	0.3 U	0.38 UJ	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, diss	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**180 D**	0.49 U	0.3 U	0.38 UJ	0.49 U	**2.5 P**	0.34 U	1.2 U	0.38 U	0.56 U	**3.2**	**1.1 P**	**5.7 P**
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***130 D***	0.49 U	0.3 U	0.38 UJ	0.49 U	***6.6***	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	**0.7 P**	**1.6 P**
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.69 U	0.49 U	0.3 U	0.38 UJ	0.49 U	1 U	0.34 U	1.2 U	0.38 U	0.56 U	0.58 U	0.43 U	0.82 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

					Location	L2-MW1							L2-MW10	L2-MW11	L2-MW2					
					Sample ID	L2MW1-010900	L2-MW1-052100	L2-MW1-20001116	L2-MW1-20010520	L2-MW1-20020605	L2-MW1-20030515	L2-MW1-0818	L2-MW10-0818	L2-MW11-0618	L2MW2-010800	L2-MW2-052000	L2-MW2-20001115	L2-MW2-20010519	L2-MW2-20020604	L2-MW2-20030515
					Sample Depth (ft)	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	40 - 50	5.5 - 15.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	1/9/2000	5/21/2000	11/16/2000	5/20/2001	6/5/2002	5/15/2003	8/30/2018	8/30/2018	6/25/2018	1/8/2000	5/20/2000	11/15/2000	5/19/2001	6/4/2002	5/15/2003
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**															
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**422000**	**440000**	**440000**	**410000**	**460000**	- -	- -	- -	**336000**	- -	**320000**	**310000**	**330000**	**330000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	**2400**	**4000**	**5000**	**4600**	**5200**	- -	- -	- -	100 U	- -	10 U	**10**	10 U	20 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**80700**	**30000**	**65000**	**180000**	**28000**	- -	- -	- -	**325000**	- -	**75000**	**500000**	150000 U	**78000**
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	***51***	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	**2100**	1000 U	**24000**	1000 U	- -	- -	- -	200 U	- -	1000 U	1000 U	**23000**	1000 U
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	**2700**	**5600**	**6400**	**5900**	**6700**	- -	- -	- -	100 U	- -	300 U	**700**	300 U	**800**
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	**4400**	**6700**	**5400**	**6300**	6900 U	- -	- -	- -	1300 U	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	**5900**	**3400**	**3000**	**2000**	**2000**	- -	- -	- -	**132000**	- -	**170000**	**150000**	**190000**	**150000**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	**0.12**	20 U	**40**	**190**	**150**	- -	- -	- -	50 U	- -	**90**	**90**	**60**	**60**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	**48900**	**89000**	**60000**	**92000**	**79000**	- -	- -	- -	**23100**	- -	**31000**	**20000**	**23000**	**21000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.17 U	0.35 U	0.68 U	1.2 U	0.77 U	0.1 U	0.1 U	0.1 U	0.03 U	0.23 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.35 U	0.84 U	1.5 U	0.77 U	0.1 U	0.1 U	0.1 U	- -	- -	0.74 U	0.87 U	0.79 U	0.35 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.17 U	0.35 U	0.68 U	1.2 U	0.77 U	0.1 U	0.1 U	0.1 U	0.04 U	0.23 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.17 U	0.35 U	0.68 U	1.2 U	0.77 U	0.1 U	0.1 U	0.1 U	0.05 U	0.23 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.34 U	0.35 U	0.68 U	1.2 U	0.77 U	0.1 U	0.1 U	0.1 U	0.05 U	0.47 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.34 U	0.35 U	0.68 U	1.2 U	0.77 U	0.1 U	0.1 U	0.1 U	0.03 U	0.47 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	35572-78-2	ino-4,6-dinitrotoluene, diss	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.34 U	0.35 U	0.68 U	1.2 U	0.77 U	0.21 U	0.2 U	0.2 U	0.06 U	0.47 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.24 U	0.34 U	0.35 U	0.68 U	1.2 U	0.77 U	0.1 U	0.1 U	0.1 U	0.09 U	0.47 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	19406-51-0	ino-2,6-dinitrotoluene, diss	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.21 U	0.2 U	0.2 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.1 U	0.1 U	0.1 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.42 U	0.35 U	0.68 U	1.2 U	0.77 U	0.1 U	**0.088 J**	0.1 U	0.06 U	0.58 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.17 U	0.35 U	0.68 U	1.2 U	0.77 U	0.1 U	0.1 U	0.1 U	0.06 U	0.23 U	0.74 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.27 U	0.17 U	0.33 U	0.68 U	1.2 U	0.77 U	0.1 U	0.1 U	0.1 U	0.31 U	0.23 U	0.7 U	0.7 U	0.64 U	0.35 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	**3.7 J**	10 U	10 U	10 U	10 U	- -	- -	- -	2.7 U	**4.5 J**	10 U	10 U	10 U	10 U
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**214**	**158**	**180 J**	**231**	**309 J**	**426**	- -	- -	- -	**163**	**198**	**238**	**224**	**213 J**	**228**
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	**0.6 J**	**0.8 J**	5 U	5 U	- -	- -	- -	0.64 U	0.4 U	**0.4 J**	**0.3 J**	5 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**105000**	**104000**	**99700**	- -	- -	- -	- -	- -	**135000**	- -	**127000**	**120000**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**15.1**	**6.3 J**	**2.2 J**	**1 J**	10 U	**1.5 J**	- -	- -	- -	**2.4**	**11**	**1.6 J**	**0.4 J**	10 U	10 U
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	1.4 U	**4.1 J**	**2.5 J**	**2.1 J**	10 U	10 U	- -	- -	- -	**4.1**	**2.4 J**	10 U	10 U	10 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**32700**	**37100**	**38600**	- -	- -	- -	- -	- -	**58300**	- -	**60800**	**59700**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	- -	- -	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	**1.8 J**	10 U	10 U	10 U	- -	- -	- -	2.9 U	2.6 U	10 U	10 U	10 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	10 U	10 U	10 U	10 U	- -	- -	- -	1.1 U	2.8 U	10 U	10 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**42900**	**46800**	**49400**	- -	- -	- -	- -	- -	**21000**	- -	**13100**	**12700**	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.17 U	0.35 U	0.68 U	1.2 U	0.77 U	- -	- -	- -	0.02 U	0.23 U	0.74 U	0.7 U	0.64 U	0.35 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

					Location	L2-MW3							L2-MW4					L2-MW5				
					Sample ID	L2MW3-010800	L2-MW3-050700	L2-MW3-20001114	L2-MW3-20010519	L2-MW3-20020605	L2-MW3-20030514	L2-MW3-0818	L2-MW4-20030510	F05-L2-MW4-GW-REG	S06-L2-MW4-GW-REG	F06-L2-MW4-GW-REG	L2-MW4-0818	L2-MW5-20030506	F05-L2-MW5-GW-REG	F05A-L2-MW5-GW-REG	S06-L2-MW5-GW-REG	F06-L2-MW5-GW-REG
					Sample Depth (ft)	15 - 25	15 - 25	15 - 25	15 - 25	15 - 25	15 - 25	15 - 25	39 - 49	39 - 49	39 - 49	39 - 49	39 - 49	38.9 - 48.9	38.9 - 48.9	38.9 - 48.9	38.9 - 48.9	38.9 - 48.9
					Sample Date	1/8/2000	5/7/2000	11/14/2000	5/19/2001	6/5/2002	5/14/2003	8/29/2018	5/10/2003	10/5/2005	4/18/2006	9/6/2006	8/28/2018	5/6/2003	9/30/2005	11/18/2005	4/14/2006	9/5/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**																	
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**184000**	- -	**95000**	**180000**	**190000**	**190000**	- -	**420000**	**406000**	**395000**	**435000**	- -	**380000**	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	100 U	- -	10 U	10 U	**10**	20 U	- -	**2900**	- -	- -	- -	- -	**4800**	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**188000**	- -	**28000**	**150000**	**84000**	**51000**	- -	**36000**	**442000**	**428000**	**495000**	- -	**33000**	- -	- -	- -	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	1000 U	1000 U	**24000**	1000 U	- -	1000 U	- -	- -	- -	- -	1000 U	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	- -	300 U	**800**	300 U	300 U	- -	**4400**	- -	- -	- -	- -	**6800**	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	**1900**	1000 U	1000 U	1000 U	- -	**4500**	**4100**	**3900**	**3900**	- -	**4200**	- -	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**3000**	- -	**3200**	**3000**	**2000**	**2000**	- -	**2000**	1600 B	**5400**	**7300**	- -	**2000**	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	52 B	50 U	50 U	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	10 U	**20**	**40**	50 U	- -	50 U	- -	- -	- -	- -	50 U	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	**280**	50 U	50 U	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**34200**	- -	**40000**	**34000**	**28000**	**46000**	- -	**11000**	**4900**	**8300**	**8800**	- -	**2000**	- -	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	1.4 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	1.4 U	0.84 U	1.1 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	1.4 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	1.4 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	1.4 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	1.4 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, disso	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	1.4 U	0.68 U	0.87 U	0.26 U	0.2 U	0.74 U	0.19 U	0.2 U	0.2 U	0.2 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.07 U	0.31 U	1.4 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, disso	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.2 U	- -	0.19 U	0.2 U	0.2 U	0.2 UJ	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.1 U	- -	0.19 U	0.2 U	0.2 U	0.1 UJ	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	1.4 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	1.4 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	0.16 U	1.3 U	0.68 U	0.87 U	0.26 U	0.1 U	0.74 U	0.19 U	0.2 U	0.2 U	0.1 UJ	0.65 U	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	2.4 U	10 U	10 U	10 U	10 U	- -	**5.4 J**	- -	- -	- -	- -	***24.6***	***68.4***	***35.9***	***43.5***	***32.8***
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	9.8 B	***23.7***	***16.2***
METALS	7440-39-3	Barium	µg/L	2000	430	**84.9**	**81**	**81.1 J**	**91.1 J**	**95 J**	**97.4 J**	- -	**617**	- -	- -	- -	- -	**373**	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	**0.3**	**0.6 J**	5 U	5 U	- -	**0.2 J**	- -	- -	- -	- -	5 U	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**51200**	- -	**59300**	**52100**	- -	- -	- -	**74400**	- -	- -	- -	- -	**72800**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**1.9**	**5.5 J**	**1.8 J**	10 U	10 U	10 U	- -	2.9 U	- -	- -	- -	- -	10 U	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**1.6**	1.7 U	10 U	10 U	10 U	10 U	- -	10 U	- -	- -	- -	- -	10 U	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**14600**	- -	**15000**	**14400**	- -	- -	- -	**32400**	- -	- -	- -	- -	**30300**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	0.02 U	- -	- -	- -	- -	0.2 U	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	10 U	10 U	10 U	10 U	- -	**0.5 J**	- -	- -	- -	- -	10 U	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	10 U	10 U	10 U	10 U	- -	**0.59 J**	- -	- -	- -	- -	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**16400**	- -	**13100**	**13700**	- -	- -	- -	**37500**	- -	- -	- -	- -	**27700**	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	1.4 U	0.68 U	0.87 U	0.26 U	- -	0.74 U	0.19 U	0.2 U	0.2 U	- -	0.65 U	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**3.24**	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**3350 E**	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2

Iowa Army Ammunition Plant, Middletown, IA

					Location		L2-MW6	L2-MW7						L2-MW8						L2-MW9
					Sample ID	S07-L2-MW5-GW-REG	L2-MW6-20030507	L2-MW7-20030507	L2-MW7-20030507-FD	F05-L2-MW7-GW-FD	F05-L2-MW7-GW-REG	S06-L2-MW7-GW-REG	F06-L2-MW7-GW-REG	L2-MW8-20030509	F05-L2-MW8-GW-REG	S06-L2-MW8-GW-REG	F06-L2-MW8-GW-REG	L2-MW8-0518	L2-MWF8-0518	L2-MW9-0818
					Sample Depth (ft)	38.9 - 48.9	9.9 - 19.9	39.5 - 49.5	39.5 - 49.5	39.5 - 49.5	39.5 - 49.5	39.5 - 49.5	39.5 - 49.5	71.4 - 81.4	71.4 - 81.4	71.4 - 81.4	71.4 - 81.4	71.4 - 81.4	71.4 - 81.4	9 - 19
					Sample Date	6/5/2007	5/7/2003	5/7/2003	5/7/2003	10/3/2005	10/3/2005	4/14/2006	9/6/2006	5/9/2003	10/3/2005	4/18/2006	9/8/2006	5/31/2018	5/31/2018	8/28/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**															
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**370000**	**340000**	- -	**336000**	**350000**	**363000**	**323000**	**420000**	**428000**	**400000**	**408000**	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	20 U	**110**	- -	- -	- -	- -	- -	**1000**	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**70000**	- -	- -	**344000**	**370000**	**424000 J**	**579000**	**65000**	**581000**	**535000**	**477000**	- -	- -	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	1000 U	- -	- -	- -	- -	- -	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	**300**	300 U	- -	- -	- -	- -	- -	**2200**	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	**1100**	- -	- -	710 B	840 B	910 B	830 B	**2200**	**2600**	**4600**	**2200**	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	**37000**	- -	**34900**	**35300**	**36400 J**	**34600**	**2000**	1000 U	**5200**	**7200**	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	***20800***	***20500***	***23200***	***14300***	- -	50 U	50 U	50 U	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	**8400**	***24000***	- -	- -	- -	- -	- -	50 U	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	50 U	50 U	50 U	50 U	- -	50 U	50 U	50 U	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	**46000**	- -	**36400**	**36900**	**37700 J**	**38600**	2000 U	1200 B	**7100**	**7800**	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, diss‹	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.21 UJ	0.21 U	0.2 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, diss‹	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	0.19 U	0.19 U	0.19 U	0.2 U	- -	0.19 U	0.2 U	0.19 U	0.21 UJ	0.21 U	0.2 UJ
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	0.19 U	0.19 U	0.19 U	0.2 U	- -	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	0.11 UJ	0.1 U	0.1 UJ
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	10 U	10 U	- -	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--	5.3 B	- -	- -	- -	- -	- -	- -	- -							
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**136 J**	- -	**459**	- -	- -	- -	- -	**117 J**	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	5 U	- -	0.04 U	- -	- -	- -	- -	5 U	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**99500**	- -	**113000**	- -	- -	- -	- -	**73400**	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	10 U	- -	**1.75**	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	10 U	- -	**0.15**	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**39800**	- -	**44800**	- -	- -	- -	- -	**33000**	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.2 U	0.02 U	- -	- -	- -	- -	- -	0.2 U	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	10 U	- -	**0.12**	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	10 U	- -	**0.04**	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**17200**	- -	**16800**	- -	- -	- -	- -	**33600**	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	- -	0.61 U	0.7 U	- -	0.19 U	0.19 U	0.19 U	0.2 U	0.38 U	0.19 U	0.2 U	0.19 U	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	1 U	1 U	- -	- -	- -	1 U	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	**0.81**	**0.86**	- -	- -	- -	**5440**	- -	- -	- -	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2

Iowa Army Ammunition Plant, Middletown, IA

					Location	L2-TT-MW01									
					Sample ID	L2-TT-MW01-FBL	L2-TT-MW01-F01R1	L2-TT-MW01-F01R2	L2-TTMW-01F01R3	L2-TT-MW01-F01R4	L2-TT-MW01-F01R5	L2-TTMW-01-F01R6	L2-TT-MW-01-01R7	L2-TT-MW01-F01R7	L2-TTMW-01-F01R8
					Sample Depth (ft)	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20
					Sample Date	8/16/2007	11/12/2007	12/27/2007	1/25/2008	3/7/2008	6/1/2008	9/26/2008	3/10/2009	3/13/2009	6/26/2009
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**182000**	**238000**	**100000**	**210000**	**210000**	**213000**	**194000**	**5700**	- -	**1500000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**401000**	**324000**	**171000**	**215000**	**444000**	**281000**	**232000**	**1290000**	- -	**2290000**
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**2900**	**24700**	**31300**	**29800**	**32200**	**1800**	**1800**	**309000**	- -	**976000**
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**3200**	**3100**	**2800**	**2300**	**2200**	**2600**	**3100**	50 U	- -	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	***1600***	50 U	**130**	**120**	50 U	50 U	500 U	- -	***2300***
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**22700**	**21300**	**22600**	**23200**	**22300**	**22300**	**20900**	1000 U	- -	1000 U
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**467000**	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**240000**	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**37800**	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**124000**	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	**469**	**378**	**324**	**374**	**344**	**353**	**336**	0.19 U	- -	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**25.4**	**16.8 J**	**17.1**	**14.4**	**14.9**	**14.2**	**20.2**	0.19 U	- -	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	19 U	0.65 JB	0.19 U	**0.34**	1.9 U	19 U	0.19 U	- -	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	***4.6***	19 U	***3.5***	***3.5***	***4.7***	***4.8***	19 U	0.19 U	- -	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***0.94***	19 U	1.9 U	0.19 U	***0.73***	1.9 U	19 U	0.19 U	- -	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***72.4***	***81.2***	***72.7***	***74.4***	***68.5***	***68.1***	***82.2***	0.19 U	- -	0.19 U
EXPLOSIVES	35572-78-2	ιino-4,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	19 U	1.9 U	0.19 U	0.19 U	1.9 U	19 U	0.19 U	- -	0.38 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***38.4***	***48.8***	***42.2***	***35.3***	***40.9***	***40.2***	***46.4***	0.19 U	- -	0.19 U
EXPLOSIVES	19406-51-0	ιino-2,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**1.3**	19 U	**3.8**	**1.5**	**2.4**	**1.8 J**	19 U	**2.8**	- -	**0.3**
EXPLOSIVES	DNX	DNX	µg/L	--	--	**6.3**	19 U	**6.1**	**5**	**4.3**	**4.1**	**5.3 J**	0.19 U	- -	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**705**	**731**	**670**	**615**	**594**	**538**	**794**	**11.4**	- -	0.19 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.2 U	19 U	1.9 U	0.19 U	0.19 U	1.9 U	19 U	0.19 U	- -	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***1310***	***1380***	***1330***	***1130***	***1220***	***1020***	***1240***	***3.4***	- -	0.19 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--										
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	15 U	15 U	15 U	15 U	54.5 B	23 U	69.9 B	***15300***	- -	***72400***
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	**25300**	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	**88.3**	**117**	**110**	- -	**123**	**116**	**106**	***21300***	- -	***43700***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	**26900**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	**0.11 J**	19 U	1.9 U	**0.073 J**	0.19 U	1.9 U	19 U	0.19 U	- -	0.19 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**0.38 J**	**0.82**	**19.8**	**74.3**	**94.3**	**97.5**	**61.9**	**285**	- -	**5310**

Table 5.3-5. Detected Chemicals in Groundwater—Line 2

Iowa Army Ammunition Plant, Middletown, IA

					Location	L2-TT-MW02												L2-TTPZ-03	L2-TTPZ-04
					Sample ID	L2-TT-MW02-FBL	L2-TT-MW02-F01R1	L2-TT-MW02-F01R2	L2-TTMW-2-F01R3	L2-TT-MW02-F01R4	L2-TT-MW02-F01R4-FD	L2-TT-MW02-F01R5	L2-TTMW-02-F01R6	L2-TT-MW-02-01R7	L2-TT-MW02-F01R7	L2-TTMW-02-F01R8	L2-TTMW02-0818	L2-TTPZ-03-F01R6	L2-TTPZ-04-F01R6
					Sample Depth (ft)	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	unknown	unknown
					Sample Date	8/22/2007	11/14/2007	12/27/2007	2/8/2008	3/7/2008	3/7/2008	6/1/2008	9/26/2008	3/11/2009	3/13/2009	6/26/2009	8/30/2018	11/2/2008	11/2/2008
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])														
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	268000	288000	238000	268000	270000	275000	270000	284000	859000	- -	578000	- -	296000	215000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	274000	467000	292000	345000	438000	558000	404000	410000	3240000	- -	1690000	- -	302000	209000
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	4300	4000	41200	54100	51500	49000	2700	3300	1050000	- -	395000	- -	2100	2300
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	6500	5100	6900	2100	3700	3900	2200	880	50 U	- -	50 U	- -	2200	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	180	2200	150	130	150	160	50 U	50 U	500 U	- -	50 U	- -	50 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	32000	33800	30600	33000	31600	31800	30500	29500	11100	- -	3500	- -	58400	47800
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	3150000	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	753000	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	22500	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	22800	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	2140	2010	2160	824	1460	1490	1320	1410	0.19 U	- -	0.19 U	0.11 U	0.19 U	19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	22.6	36.7	44.5	21.7	28	25.9	32.1	33.9 J	0.19 U	- -	0.19 U	0.11 U	16.1	45.7
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	35	19.4	31.5 B	14.7	22.2	18.4	25.8	26.9 J	0.19 U	- -	0.19 U	0.11 U	0.19 U	19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	6.7	2.1 J	2 U	3.9	3	3.8	1.7 J	38 U	0.19 U	- -	0.19 U	0.11 U	1.1	19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	11.3	3.9 U	6.9	4.7	0.97 J	4.6	3.5	38 U	0.19 U	- -	0.19 U	0.11 U	0.19 U	19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	216	196	209	139	179	167	160	190	0.19 U	- -	0.19 U	0.11 U	13.4	12 J
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.8 U	3.9 U	2 U	2 U	1.9 U	1.9 U	1.9 U	38 U	0.19 U	- -	0.76 U	0.21 U	0.19 U	19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	153	155	173	118	141	134	103	106	0.19 U	- -	0.19 U	0.11 U	8.5	40.5
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, dissc	µg/L	1.9	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	8.6	5	7	8	4.7	4.3	3.9	38 U	3.8 U	- -	0.95 U	0.21 U	5.1	10.8 J
EXPLOSIVES	DNX	DNX	µg/L	--	--	4.2	11.7	9.9	8.2	5.1	5.5	8.9	38 U	0.19 U	- -	0.19 U	0.11 U	6.2	10.1 J
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	420	1320	1340	794	1150	935	848	1110	143	- -	3.8 U	0.11 U	205	53.3
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.8 U	3.9 U	2 U	2 U	1.9 U	1.9 U	1.9 U	38 U	0.19 U	- -	0.19 U	0.11 U	0.19 U	19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	2000	5270	4450	2260	3340	2790 B	2170	2570	0.53	- -	0.19 U	0.11 U	675	1290
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--														
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	720	46.7 B	100 B	38.8 B	15 U	15 U	23 U	23 U	106000	- -	61600	- -	9930	740
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	101	86	41.6	1740	1050	1070	474	267	38800	- -	23700	- -	270	93.1
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	44600	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.69 J	3.9 U	2 U	2 U	1.9 U	1.9 U	1.9 U	38 U	0.19 U	- -	0.19 U	- -	0.19 U	19 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	0.29 J	0.38 J	0.19 J	0.57	1.62	1.77	13.6	26.9	49.5	- -	440	- -	0.24 J	1.43

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

					Location	L2-TTPZ-05	L2-TTPZ-06		L2-TTTW-001	L2-TTTW-002
					Sample ID	L2-TTPZ-05-F01R6	L2-TTPZ-06-F01R6	L2-TTPZ-06-F01R6A	L2-TTTW-001	L2-TTTW-002
					Sample Depth (ft)	unknown	unknown	unknown	unknown	unknown
					Sample Date	11/2/2008	10/19/2008	10/20/2008	2/13/2007	2/14/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**					
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**366000**	**196000**	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**354000**	**237000**	- -	- -	- -
GENERAL	7723-14-0	Orthophosphate	µg/L	0.4	--	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	TDS	Total dissolved solids	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**4600**	**1300**	- -	- -	- -
GENERAL	TSS	Total suspended solids	µg/L	--	--	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	50 U	**170**	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	50 U	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**53300**	**38900**	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.19 U	- -	0.22 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**1.3**	**0.47**	- -	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	0.19 U	- -	**0.19 J**	**0.15 J**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.19 U	- -	0.22 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	0.19 U	- -	0.22 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	0.19 U	- -	0.22 U	0.19 U
EXPLOSIVES	35572-78-2	ıino-4,6-dinitrotoluene, diss(	µg/L	1.9	--	- -	- -	- -	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.19 U	- -	0.22 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**0.21**	**0.19**	- -	0.22 U	0.19 U
EXPLOSIVES	19406-51-0	ıino-2,6-dinitrotoluene, diss(	µg/L	1.9	--	- -	- -	- -	- -	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**0.99**	0.38 U	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	**0.42**	0.19 U	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**1.9**	**38.8**	- -	0.22 U	0.19 U
EXPLOSIVES	2691-41-0	HMX, dissolved	µg/L	1000	--	- -	- -	- -	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.2 U	0.19 U	- -	0.22 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***14.4***	***9***	- -	0.22 U	0.19 U
EXPLOSIVES	121-82-4	RDX, dissolved	µg/L	2	--	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -
METALS	7440-38-2	Arsenic, dissolved	µg/L	10	--					
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	55.5 B	23 U	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	***530***	***1810***	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.2 U	0.19 U	- -	0.22 U	0.19 U
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**2.59**	- -	**51.9**	- -	- -

Table 5.3-5. Detected Chemicals in Groundwater—Line 2
Iowa Army Ammunition Plant, Middletown, IA

Notes:

DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol

B = The analyte was detected in the associated method and/or calibration blank.

D = Diluted sample.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated

JB = The analyte detected in the associated field, equipment, and/or trip blank.

P = Sample failed confirmation precision criteria.

U = The analyte was analyzed for, but was not detected above

UJ = The analyte was below the reported sample quantitation

-- = Not Analyzed

µg/L = micrograms per liter

cells/mL = cells per milliliter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)

(1) UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.3-6. Groundwater Quality Parameters—Line 2

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water[a] (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (uS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
G-15	4/22/2018	12.03	6.5	9.36	556	144.9	5.44	22.9
L2-TT-MW02	8/30/2018[c]	6.5	NA	NA	NA	NA	NA	NA
JAW-70	8/28/2018	7.3	7.16	15.89	504	289	8.36	90
JAW-71	8/28/2018	9.61	6.97	21.14	438	289.9	1.78	5.11
JAW-73	8/29/2018	12.42	6.72	14.66	568	-8.3	2.88	3.26
JAW-74	8/29/2018	11.89	5.78	16.36	482	107.2	0.71	2.31
JAW-75	8/30/2018[c]	12.54	NA	NA	NA	NA	NA	NA
12-A	8/28/2018	11.72	7.22	25.57	547	228	2.18	5.1
12-C	8/29/2018	10.48	7.24	13.6	718	-162	0.45	393
12-F	8/29/2018	8.28	7.35	13.7	1090	-186	0.38	137
L2-MW1	8/30/2018[c]	13.3	NA	NA	NA	NA	NA	NA
L2-MW3	8/29/2018	9.85	6.9	14.25	525	53.4	1.39	10.2
L2-MW4	8/28/2018	6.15	7.27	17.31	719	-133	0.51	14.5
L2-MW8	5/31/2018	0	7.06	12.8	740	-84.8	0.47	70.5
L2-MW9	8/28/2018	10.55	7.41	20.97	506	267.2	2.32	overrange
L2-MW10	8/30/2018[c]	15.62	NA	NA	NA	NA	NA	NA
L2-MW11	6/25/2018	10.15	6.61	13.6	434	29.9	0.3	13.5

Notes:

Water quality parameters were measured in the field using a YSI multi-meter.

[a]Depth to water measurements collected during the site-wide gauging survey on 8/28/2018.

[b]Well could not be located during 2018 gauging event.

cPurge logs unavailable from 8/30/2018.

°C = degrees Celsius
DO = dissolved oxygen
mV = millivolt(s)
NTU = nephelometric turbidity unit
ORP = oxidation-reduction potential
ug/L = microgram(s) per liter
uS/cm = microsiemen(s) per centimeter
ft = feet
btoc = below top of casing
NA = Not Available

Table 5.3-8. Data Groupings Used in the HHRA - Line 2

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group	Description	Sample Count
Line2_GW-All_Organics	Line 2 groundwater (locations at all depths). Data grouping used to evaluate organic chemicals.	13
Line2_GW-All_Metals	Line 2 groundwater (locations at all depths). Data grouping used to evaluate metals.	23
Line2_GW-Plume_Organics	Line 2 groundwater (locations within the groundwater plume). Data grouping used to evaluate organic chemicals.	3
Line2_GW-Plume_Metals	Line 2 groundwater (locations within the groundwater plume). Data grouping used to evaluate metals.	3
Line2_GW-Shallow_Organics	Line 2 shallow groundwater (locations with depth to water table ≤10 feet below ground surface). Data grouping used to evaluate organic chemicals.	13
Line2_GW-Shallow_Metals	Line 2 shallow groundwater (locations with depth to water table ≤10 feet below ground surface). Data grouping used to evaluate metals.	22
Offsite_GW-All_Organics	Offsite groundwater (locations at all depths). Data grouping used to evaluate organic chemicals.	4
Offsite_GW-All_Metals	Offsite groundwater (locations at all depths). Data grouping used to evaluate metals.	2
Offsite_GW-Plume_Organics	Offsite groundwater (locations within the groundwater plume). Data grouping used to evaluate organic chemicals.	2
Offsite_GW-Plume_Metals	Offsite groundwater (locations within the groundwater plume). Data grouping used to evaluate metals.	2
Offsite_GW-Shallow_Organics	Offsite shallow groundwater (locations with depth to water table ≤10 feet below ground surface). Data grouping used to evaluate organic chemicals.	3
Offsite_GW-Shallow_Metals	Offsite shallow groundwater (locations with depth to water table ≤10 feet below ground surface). Data grouping used to evaluate metals.	2

Table 5.3-9. Samples Used in the HHRA - Line 2
Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Sample Type (1)	Upper Depth (Feet)	Lower Depth (Feet)
Line2_GW-All_Organics	WG	12-A	L2-A-0818	8/28/2018	N	10.5	20.5
Line2_GW-All_Organics	WG	12-C	L2-12-C-0818	8/29/2018	N	40.2	50.2
Line2_GW-All_Organics	WG	12-F	L2-12-F-0818	8/29/2018	N	40.4	50.4
Line2_GW-All_Organics	WG	JAW-70	JAW70-0818	8/28/2018	N	7	17
Line2_GW-All_Organics	WG	JAW-71	JAW-71-0818	8/28/2018	N	7	17
Line2_GW-All_Organics	WG	JAW-73	JAW-73-0818	8/29/2018	N	10	20
Line2_GW-All_Organics	WG	JAW-74	L2-JAW-74-0818	8/29/2018	N	12	22
Line2_GW-All_Organics	WG	JAW-75	L2-JAW-75-0818	8/30/2018	N	7	17.5
Line2_GW-All_Organics	WG	L2-MW1	L2-MW1-0818	8/30/2018	N	25	35
Line2_GW-All_Organics	WG	L2-MW3	L2-MW3-0818	8/29/2018	N	15	25
Line2_GW-All_Organics	WG	L2-MW4	L2-MW4-0818	8/28/2018	N	39	49
Line2_GW-All_Organics	WG	L2-MW9	L2-MW9-0818	8/28/2018	N	9	19
Line2_GW-All_Organics	WG	L2-TT-MW02	L2-TTMW02-0818	8/30/2018	N	10	20
Line2_GW-All_Metals	WG	12-A	12-A-20030514	5/14/2003	N	10.5	20.5
Line2_GW-All_Metals	WG	12-B	12-B-20030514	5/14/2003	N	10.5	20.5
Line2_GW-All_Metals	WG	12-C	12-C-20030515	5/15/2003	N	40.2	50.2
Line2_GW-All_Metals	WG	12-C	F06-12-C-GW-REG	8/31/2006	N	40.2	50.2
Line2_GW-All_Metals	WG	12-D	12-D-20030516	5/16/2003	N	120	130
Line2_GW-All_Metals	WG	12-E	12-E-20030514	5/14/2003	N	9.5	19.5
Line2_GW-All_Metals	WG	12-F	12-F-20030515	5/15/2003	N	40.4	50.4
Line2_GW-All_Metals	WG	12-F	F06-12-F-GW-REG	8/31/2006	N	40.4	50.4
Line2_GW-All_Metals	WG	12-G	12-G-20030516	5/16/2003	N	10.3	20.3
Line2_GW-All_Metals	WG	JAW-70	F04-GW-052	11/16/2004	N	7	17
Line2_GW-All_Metals	WG	JAW-71	JAW-71-20030516	5/16/2003	N	7	17
Line2_GW-All_Metals	WG	JAW-72	F04-GW-051	11/16/2004	N	10	20
Line2_GW-All_Metals	WG	JAW-73	JAW-73-20030516	5/16/2003	N	10	20
Line2_GW-All_Metals	WG	JAW-74	JAW-74-20030515	5/15/2003	N	12	22
Line2_GW-All_Metals	WG	JAW-75	JAW-75-20030515	5/15/2003	N	7	17.5
Line2_GW-All_Metals	WG	L2-MW1	L2-MW1-20030515	5/15/2003	N	25	35
Line2_GW-All_Metals	WG	L2-MW2	L2-MW2-20030515	5/15/2003	N	7.5	17.5
Line2_GW-All_Metals	WG	L2-MW3	L2-MW3-20030514	5/14/2003	N	15	25
Line2_GW-All_Metals	WG	L2-MW4	L2-MW4-20030510	5/10/2003	N	39	49
Line2_GW-All_Metals	WG	L2-MW5	F06-L2-MW5-GW-REG	9/5/2006	N	38.9	48.9
Line2_GW-All_Metals	WG	L2-MW5	L2-MW5-20030506	5/6/2003	N	38.9	48.9
Line2_GW-All_Metals	WG	L2-MW6	L2-MW6-20030507	5/7/2003	N	9.9	19.9
Line2_GW-All_Metals	WG	L2-MW7	L2-MW7-20030507	5/7/2003	N	39.5	49.5
Line2_GW-Plume_Organics	WG	JAW-70	JAW70-0818	8/28/2018	N	7	17
Line2_GW-Plume_Organics	WG	JAW-71	JAW-71-0818	8/28/2018	N	7	17
Line2_GW-Plume_Organics	WG	L2-MW4	L2-MW4-0818	8/28/2018	N	39	49
Line2_GW-Plume_Metals	WG	JAW-70	F04-GW-052	11/16/2004	N	7	17
Line2_GW-Plume_Metals	WG	JAW-71	JAW-71-20030516	5/16/2003	N	7	17
Line2_GW-Plume_Metals	WG	L2-MW4	L2-MW4-20030510	5/10/2003	N	39	49
Line2_GW-Shallow_Organics	WG	12-A	L2-A-0818	8/28/2018	N	10.5	20.5
Line2_GW-Shallow_Organics	WG	12-C	L2-12-C-0818	8/29/2018	N	40.2	50.2
Line2_GW-Shallow_Organics	WG	12-F	L2-12-F-0818	8/29/2018	N	40.4	50.4
Line2_GW-Shallow_Organics	WG	JAW-70	JAW70-0818	8/28/2018	N	7	17
Line2_GW-Shallow_Organics	WG	JAW-71	JAW-71-0818	8/28/2018	N	7	17
Line2_GW-Shallow_Organics	WG	JAW-73	JAW-73-0818	8/29/2018	N	10	20
Line2_GW-Shallow_Organics	WG	JAW-74	L2-JAW-74-0818	8/29/2018	N	12	22
Line2_GW-Shallow_Organics	WG	JAW-75	L2-JAW-75-0818	8/30/2018	N	7	17.5
Line2_GW-Shallow_Organics	WG	L2-MW1	L2-MW1-0818	8/30/2018	N	25	35
Line2_GW-Shallow_Organics	WG	L2-MW3	L2-MW3-0818	8/29/2018	N	15	25
Line2_GW-Shallow_Organics	WG	L2-MW4	L2-MW4-0818	8/28/2018	N	39	49
Line2_GW-Shallow_Organics	WG	L2-MW9	L2-MW9-0818	8/28/2018	N	9	19
Line2_GW-Shallow_Organics	WG	L2-TT-MW02	L2-TTMW02-0818	8/30/2018	N	10	20
Line2_GW-Shallow_Metals	WG	12-A	12-A-20030514	5/14/2003	N	10.5	20.5
Line2_GW-Shallow_Metals	WG	12-B	12-B-20030514	5/14/2003	N	10.5	20.5

Table 5.3-9. Samples Used in the HHRA - Line 2
Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Sample Type (1)	Upper Depth (Feet)	Lower Depth (Feet)
Line2_GW-Shallow_Metals	WG	12-C	12-C-20030515	5/15/2003	N	40.2	50.2
Line2_GW-Shallow_Metals	WG	12-C	F06-12-C-GW-REG	8/31/2006	N	40.2	50.2
Line2_GW-Shallow_Metals	WG	12-E	12-E-20030514	5/14/2003	N	9.5	19.5
Line2_GW-Shallow_Metals	WG	12-F	12-F-20030515	5/15/2003	N	40.4	50.4
Line2_GW-Shallow_Metals	WG	12-F	F06-12-F-GW-REG	8/31/2006	N	40.4	50.4
Line2_GW-Shallow_Metals	WG	12-G	12-G-20030516	5/16/2003	N	10.3	20.3
Line2_GW-Shallow_Metals	WG	JAW-70	F04-GW-052	11/16/2004	N	7	17
Line2_GW-Shallow_Metals	WG	JAW-71	JAW-71-20030516	5/16/2003	N	7	17
Line2_GW-Shallow_Metals	WG	JAW-72	F04-GW-051	11/16/2004	N	10	20
Line2_GW-Shallow_Metals	WG	JAW-73	JAW-73-20030516	5/16/2003	N	10	20
Line2_GW-Shallow_Metals	WG	JAW-74	JAW-74-20030515	5/15/2003	N	12	22
Line2_GW-Shallow_Metals	WG	JAW-75	JAW-75-20030515	5/15/2003	N	7	17.5
Line2_GW-Shallow_Metals	WG	L2-MW1	L2-MW1-20030515	5/15/2003	N	25	35
Line2_GW-Shallow_Metals	WG	L2-MW2	L2-MW2-20030515	5/15/2003	N	7.5	17.5
Line2_GW-Shallow_Metals	WG	L2-MW3	L2-MW3-20030514	5/14/2003	N	15	25
Line2_GW-Shallow_Metals	WG	L2-MW4	L2-MW4-20030510	5/10/2003	N	39	49
Line2_GW-Shallow_Metals	WG	L2-MW5	F06-L2-MW5-GW-REG	9/5/2006	N	38.9	48.9
Line2_GW-Shallow_Metals	WG	L2-MW5	L2-MW5-20030506	5/6/2003	N	38.9	48.9
Line2_GW-Shallow_Metals	WG	L2-MW6	L2-MW6-20030507	5/7/2003	N	9.9	19.9
Line2_GW-Shallow_Metals	WG	L2-MW7	L2-MW7-20030507	5/7/2003	N	39.5	49.5
Offsite_GW-All_Organics	WG	G-15	G15-0418	4/22/2018	N	6.5	16.5
Offsite_GW-All_Organics	WG	L2-MW10	L2-MW10-0818	8/30/2018	N	40	50
Offsite_GW-All_Organics	WG	L2-MW11	L2-MW11-0618	6/25/2018	N	5.5	15.5
Offsite_GW-All_Organics	WG	L2-MW8	L2-MW8-0518	5/31/2018	N	71.4	81.4
Offsite_GW-All_Metals	WG	G-15	F04-GW-053	11/16/2004	N	6.5	16.5
Offsite_GW-All_Metals	WG	L2-MW8	L2-MW8-20030509	5/9/2003	N	71.4	81.4
Offsite_GW-Plume_Organics	WG	G-15	G15-0418	4/22/2018	N	6.5	16.5
Offsite_GW-Plume_Organics	WG	L2-MW8	L2-MW8-0518	5/31/2018	N	71.4	81.4
Offsite_GW-Plume_Metals	WG	G-15	F04-GW-053	11/16/2004	N	6.5	16.5
Offsite_GW-Plume_Metals	WG	L2-MW8	L2-MW8-20030509	5/9/2003	N	71.4	81.4
Offsite_GW-Shallow_Organics	WG	G-15	G15-0418	4/22/2018	N	6.5	16.5
Offsite_GW-Shallow_Organics	WG	L2-MW11	L2-MW11-0618	6/25/2018	N	5.5	15.5
Offsite_GW-Shallow_Organics	WG	L2-MW8	L2-MW8-0518	5/31/2018	N	71.4	81.4
Offsite_GW-Shallow_Metals	WG	G-15	F04-GW-053	11/16/2004	N	6.5	16.5
Offsite_GW-Shallow_Metals	WG	L2-MW8	L2-MW8-20030509	5/9/2003	N	71.4	81.4

Notes:

(1) The data were reduced such that when a normal and duplicate sample were available, the highest detected concentration among normal or duplicate samples was used when a chemical was detected in any sample. If both results were non-detect, the lowest reported detection limit (i.e., reporting limit) was used.

WG = groundwater

N = normal

Table 5.4-1. Previous Investigations and Remedial Actions—Line 3

Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Installation Assessment of IAAAP (USATHAMA, 1980)	1980	A records search was conducted to assess the use, storage, treatment, and disposal of toxic and hazardous materials at IAAAP regarding environmental quality.	Line 3 was identified as conventional LAP facility for heavy artillery projectiles, and also a metal treatment (brass) facility. A follow-on preliminary survey was recommended to define the level of contaminants that may be migrating beyond the installation boundaries.
Contamination Survey (ERG, 1982)	1981	Two soil samples were collected and analyzed for explosives, metals, SVOCs, PCBs, pesticide, and general chemistry.	Low levels of explosives, metals, SVOCs, and PCBs were detected in both soil samples.
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	1991	A preliminary assessment was conducted for Line 3A to evaluate the potential for contamination and assess potential migration pathways and exposure potential if contamination were present. A 1988 release of contaminated wastewater from the sump next to Building 3-05-01 was identified.	It was recommended that sampling be conducted to determine the presence or absence of the chemicals used at Line 3A. The predominant wastes for this area were assumed to be explosives (TNT, PBX, RDX, and Composition B).
Facility-wide Site Inspection (JAYCOR, 1992)	1991	Six surface soil samples, seven subsurface soil samples, and one colocated surface water/sediment sample were analyzed for VOCs, SVOCs, explosives, metals, and pesticides. Samples were collected near buildings historically used for storing, generating, or treating process waste and their associated drainages.	Elevated concentrations of explosives, metals, and pesticides were detected in soil, and explosives were detected in surface water above the SI criteria. As a result of these findings, further investigation was scheduled to be completed under the RI for Line 3.
Facility-wide Phase I Remedial Investigation (JAYCOR, 1993a, 1993b)	1992	Phase I RI sampling included soil, soil gas, surface water, sediment, and groundwater sampling. • Two-hundred thirty explosives and 672 metals screening samples were collected in soil; approximately 10 percent of screening samples were shipped to an offsite laboratory for confirmation analysis. Sample locations were concentrated around production buildings. • Twenty-two surface soil samples (0 to 0.5 feet bgs) were collected around production buildings and analyzed for VOCs, SVOCs, explosives, and metals. • Twenty-one soil gas samples were screened using three methods: laboratory analysis following soil vapor extraction, soil headspace analysis of soil samples collected at depth, and analysis of groundwater from piezometers installed near potential sources. Sample locations were concentrated around production buildings.	Thirty-eight of the 135 surface soil screening samples had detectable levels of explosives, and 267 of the 332 surface soil screening samples contained detectable concentrations of metals. Concentrations of both explosives and metals diminished with depth (primarily detected at less than 3 feet bgs), and these chemicals were generally not detected 10–20 feet away from the most impacted soil areas. The most explosives-impacted soils noted were at wastewater sumps, foundations of melt buildings where wastewater was generated, and loading docks. The highest concentration levels of RDX and TNT in soils were collected at Buildings 3-05-02 and 3-05-01 and around their smaller associated buildings (with 43 samples exceeding 100 mg/kg). Elevated metals in soil were more widespread throughout the building areas than explosives. Lead was detected above the OU-1 RG over much of the line, ranging from 1,230 mg/kg (south of Building 35-05-01) to 6,176 mg/kg (Building 3-99-2). Arsenic and antimony levels above the OU-1

Table 5.4-1. Previous Investigations and Remedial Actions—Line 3

Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
		• Four co-located surface water/sediment samples associated with a NPDES outfall at Building 3-05-2 were collected and analyzed for VOCs, SVOCs, explosives, and metals. Five facility-wide surface water and six sediment samples were collected from two intermittent streams which drain portions of Line 3 and analyzed for VOCs, SVOCs, explosives, and metals. • Six piezometers were installed and sampled for explosives. An independent sump survey was conducted on three sumps within Line 3. Seven co-located surface and subsurface soil samples were collected around these sumps. The water in the sumps were sampled for metals and explosives.	RGs were detected in several samples. Copper was identified as an ecological risk driver for areas around Building 3-01 and in drainage ditches leading east of the site. Low levels of SVOCs were detected in soil samples throughout Line 3, with PAHs detected above OU-1 RGs in one sample. Only one soil sample had detectable levels of VOCs (toluene at 0.0016 µg/L). Seven of the 21 soil gas sample locations had detectable levels of total VOCs, with a maximum concentration of 1,462 µg/L. Only low levels of acetone were detected in the confirmation soil samples, with 0.055 µg/g of acetone reported in the soil sample collected where the soil gas screening sample indicated 1,462 µg/L of total VOCs. Explosives were detected in surface water and sediment samples collected in the drainage channel downgradient of NPDES discharges at Line 3; surface water explosives concentrations were within the permitted NPDES limitations. Elevated explosives (maximum 5,400 µg/L) were also detected in sump water samples. Low levels of metals were detected in surface water and sediment samples; surface water concentrations were within permitted NPDES limitations. SVOCs were not detected in surface water/sediment samples, and only one surface water sample had detectable levels of VOCs (chloroform, bromodichloromethane, and ethylbenzene at 27.0 µg/L, 4.6 µg/L, and 0.9 µg/L, respectively). Explosives were detected in groundwater samples from two monitoring wells and one piezometer, with a maximum concentration of 2,110 µg/L. Groundwater samples from four monitoring wells had lead concentrations ranging from 1.0 to 10 µg/L. VOCs were not detected in any of the follow-on groundwater samples. The RI recommended semiannual compliance groundwater monitoring at Line 3 for explosives and metals for compliance with the hazardous waste management regulations for permitted facilities (40 CFR Part 264), specifically, Subpart F of these regulations, "Releases from Solid Waste Management Units."
Follow-on Remedial Investigation (JAYCOR, 1996)	1993–1995	Phase II RI investigations consisted of monitoring well installation and sampling, subsurface soil sampling during well installations, and surface water/sediment sampling. Six monitoring wells were installed and sampled for metals and explosives. Continuous soil samples were collected during monitoring well installation, and one sample from each well location was submitted for metals and explosives analysis. Four colocated surface water/sediment samples were collected from drainageways south and west of Line 3. In October 1994, JAYCOR performed independent melt basement sampling of Building 3-05-2. One water and five sediment samples were collected and analyzed for VOCs, SVOCs, metals, and explosives. Additional follow-on sampling was conducted in 1995. Three co-located surface and subsurface soil samples were collected around Building 3-140-2 sumps. Groundwater samples from monitoring wells JAW-53, JAW-55, and JAW-56 were sampled for VOCs. Two co-located surface water and sediment samples were collected in drainages east of Line 3, where the drainages exits the line, and analyzed for metals and explosives. Two soil samples were collected and analyzed at previous soil gas screening locations and analyzed for VOCs via laboratory.	

Table 5.4-1. Previous Investigations and Remedial Actions—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Sump Removal Action (OHM, 1996)	1995	Three concrete sumps were removed from former Buildings 3-05-1 (two locations) and 3-50. Fifty-eight cubic yards of soil contaminated with metals and explosives and material was excavated.	Based on confirmation sampling, no soil with concentrations above OU-1 RGs remains in the excavated areas, with the exception of the excavation south of Building 3-05-1, where the confirmation sample collected from the east wall (1.97 mg/kg) was slightly above the OU-1 RG for RDX. However, no further excavation to the east was possible due to site utilities. The area may be evaluated further when the building is removed, as warranted.
Periodic Groundwater Monitoring (multiple reports)	1994–2008	Periodic groundwater sampling was conducted at Line 3 per the FFA and recommendations in the 1996 RI. Samples were analyzed for explosives and metals.	Explosives were detected in wells screened in the shallow zones of the overburden aquifer and in shallow bedrock. One SVOC detected sporadically across the site in 1997 was attributed to the sampling method/equipment. One VOC, methylene chloride, detected above the screening level in 1997, was attributed to laboratory contamination. Three metals detected above screening levels in 1997 were attributed to metals-contaminated acid at the laboratory. During the last event in 2008, RDX was detected at 234 µg/L.
Supplemental Groundwater RI (MWH, 2001)	1997	Three soil samples and one DPT groundwater sample were collected from one boring, located directly north of Building 3-03 and analyzed for VOCs. Five new monitoring wells were installed, and groundwater samples were collected from the five new wells and three existing wells to further characterize the vertical and lateral extents of groundwater contamination and assess the extent to which contaminants may be reaching Brush Creek. Groundwater samples were analyzed for explosives, TAL metals, VOCs, SVOCs, and groundwater quality parameters.	Freon 113 and 1,2,4-trimethylbenzene were detected in soil, while Freon 113 was detected in groundwater. In groundwater, explosives and bis(2-ethylhexy)phthalate were detected above screening criteria. It was concluded that the lateral extent of explosives contamination at Line 3 was limited to a small area near two wells (JAW55 and H16A). Contaminants from Line 3 do not appear to have reached Brush Creek. Explosives contamination was present primarily in shallow groundwater; however, exceedances were observed in deep well H16A. It was concluded that this detection may be result of the well drilling and installation process, and continued monitoring should determine whether explosives actually are present.
OU-1 Record of Decision (Department of the Army and USEPA, 1998)	1998	The Final ROD for OU-1 was issued to address contaminated soils at IAAAP. The ROD presented the selected remedial action for OU-1.	The selected remedy included excavation for soil contaminated with metals, explosives, SVOCs, and radionuclides at Line 3.

Table 5.4-1. Previous Investigations and Remedial Actions—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Line 3 Feasibility Study Data Collection and Remedial Alternatives Analysis (URS, 2004b)	2002–2003	To support the development of a Feasibility Study for Line 3, a field survey, geologic soil logging and geotechnical sampling, DPT groundwater sampling, monitoring well installation and sampling, and aquifer slug testing were conducted. Twenty DPT groundwater samples were collected from temporary wells in the vicinity of Brush Creek and analyzed for explosives. Two new monitoring wells were installed within the intermediate overburden aquifer and sampled for explosives, SVOCs, metals, and natural attenuation parameters. The FS report also considered the periodic groundwater monitoring data from 11 existing wells, which were sampled for explosives, metals, and natural attenuation parameters. Groundwater flow and contaminant fate and transport in the saturated zone at Line 3 was modeled using the MODFLOW and MT3DMS numerical computer modeling programs, respectively. A risk assessment was completed to assess potential risk to human health associated with current or future exposures to groundwater at Line 3.	A small explosives plume, consisting primarily of RDX and HMX, was observed around shallow monitoring well JAW-54 . The vertical extent of the plume appeared to be restricted to the shallow aquifer zone, as no explosives were detected in groundwater samples from the intermediate or deep glacial till. No metals were detected above their MCLs. The groundwater fate and transport model predicted that explosives concentrations in groundwater should continue to decline over time due to the naturally occurring processes of dispersion and biodegradation. While the RDX plume may continue to migrate, it would not reach Brush Creek. The initial natural attenuation evaluation indicated natural attenuation processes may be significant for the Line 3 RDX plume, as concentrations and mass have decreased over time, RDX degradation products were detected in groundwater, and geochemical conditions were favorable for anaerobic biodegradation. Two explosives (RDX and 2,4-DNT) were identified as COPCs for groundwater. Following the risk assessment, three remedial alternatives were evaluated to prevent commercial/industrial worker ingestion of RDX in groundwater for inclusion in the FS report.
IAAAP Sampling and Reconnaissance of Brush Creek (CCJM, 2004)	2003	One co-located surface water/sediment sample was collected upstream of the confluence of the Line 3 tributary and Brush Creek, and one co-located surface water/sediment sample was collected downstream of the confluence. Samples were analyzed for RDX.	RDX was detected in both surface water samples at 10.7 µg/L. RDX was detected in the upstream sediment sample at 1.73 µg/g, but not detected in the downstream sample.
OU-1 Supplemental RI (Tetra Tech, 2007)	2003–2006	Approximately 210 soil samples were collected and analyzed for explosive, metals, PAHs, PCBs, and SVOCs. Sample locations targeted known contaminated areas that were not sufficiently delineated during the RI and buildings/areas that had not been previously sampled but were considered likely sources or transport pathways from likely sources.	2,4,6-TNT, 2,4-DNT, RDX, lead, arsenic, copper, antimony, and PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenz[ah]anthracene, and indeno[1,2,3-3,d]pyrene) were detected above OU-1 RGs. These chemicals were identified as soil COCs at Line 3. PAHs only exceeded the OU-1 RGs in one sample collected west of Building 3-70-1.

Table 5.4-1. Previous Investigations and Remedial Actions—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Historical Records Review (Shaw, 2005a)	2005	A Historical Records Review was conducted for nine areas at IAAAP.	Based on review of the historical operations information, potential chemical release sources at Line 3 facilities include the following: explosives-contaminated wastewater from sump overflows, solvent and paint remover wastes from paint stripping and renovation operations, contaminated wastewater from production room washdowns onto the ground or into nearby drainage ways, occasional spills at material receiving docks, and dust releases from open windows and doors that could settle on nearby property.
Comprehensive Watersheds Evaluation and Supplemental Data Collection (Tetra Tech, 2006b)	2005	A comprehensive evaluation was conducted of all IAAAP sites and the four primary watersheds (Brush Creek, Spring Creek, Long Creek, and Skunk River) to identify data gaps and additional data needed to complete a feasibility study for surface water and groundwater at each of the IAAAP sites.	The work plan concluded that groundwater contamination was adequately characterized, and no further groundwater sampling was recommended. Slightly elevated concentrations of explosives were found in surface water. It noted that additional Investigation of surface water would take place as part of the Brush Creek surface water and sediment investigation work plan for OU-4, and additional investigation of soil would take place as part of a remedial design/remedial action work plan for soils under OU-1.
Remedial Action for OU-1 Soils Phase 5, 7, and 8 Sites (Tetra Tech, 2009a)	2006	Contaminated soil (3,443 cubic yards) was removed to a maximum depth of 4 feet bgs from 35 excavation areas. Seven soil/sediment samples were collected in August 2006 downstream of the security fence and analyzed for copper to inform the extent of one of the excavations driven by ecological risk.	Based on confirmation sampling, soil with concentrations above OU-1 RGs was removed with two exceptions. Contaminated soil along the east wall of excavation 12 (L3-E12), located south of Building 3-05-1, could not be removed without destroying utilities. Contaminated soil along the west wall of excavation 26 (L3-E26), located south of Building 3-06-1, could not be removed without undermining the foundation of the building.
OU-6 Supplemental Remedial Investigation (Tetra Tech, 2012a)	2006	Three surface water samples were collected, one from the Brush Creek tributary between Line 3 and Brush Creek, and two from Brush Creek downstream of the confluence of the tributary and Brush Creek. Samples were analyzed for explosives.	The surface water sample closest to Line 3 contained RDX (5.5 µg/L) slightly above the HAL; the other two samples collected in Brush Creek contained similar RDX concentrations, greater than those in the upstream sample.
Brush Creek Tributary Surface Water Sampling (Tetra Tech, 2010)	2009	Surface water samples were collected at four locations along the outside of the perimeter fence of Line 3 and were analyzed for explosives. Sample locations were selected to represent runoff from various production buildings throughout Line 3.	RDX was detected in three of the four samples at low levels below the recreational screening level, indicating Line 3 is not a significant contributor of RDX to Brush Creek.

Table 5.4-1. Previous Investigations and Remedial Actions—Line 3
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Explanation of Significant Differences for the Records of Decision Soils OU-1 (Leidos, 2018)	2018	Documented the addition of LUCs to the selected remedy for the Soils ROD to provide overall protectiveness of human health and the environment.	The Explanation of Significant Differences changes will apply to soil at Line 3.
OU-1 Land Use Controls Implementation Plan (Leidos, 2019)	2019	Outlined the process for implementation and maintenance of LUCs as a component of the selected remedy for OU-1. Institutional controls will be used to restrict land use at OU-1 Areas to military, commercial/industrial, agricultural, and permitted hunting and prohibit residential use. Engineering controls (fencing, signs) will be used to prevent general access to areas.	The scope of the LUCIP applies to the Line 3.

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	16-A							
					Sample ID	H16A-010900	16A-052100	16-A-20001116	16-A-20010522	16-A-20020603	16-A-20030519	F05-16-A-GW-REG	S06-16-A-GW-REG
					Sample Depth (ft)	99.4 - 109.4	99.4 - 109.4	99.4 - 109.4	99.4 - 109.4	99.4 - 109.4	99.4 - 109.4	99.4 - 109.4	99.4 - 109.4
					Sample Date	1/9/2000	5/21/2000	11/16/2000	5/22/2001	6/3/2002	5/19/2003	10/5/2005	4/13/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**502000**	- -	**480000**	**492000**	**490000**	**500000**	**483000**	**498000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**1900**	- -	**1400**	**1700**	**1700**	**1600**	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**451000**	- -	**42000**	**80000**	**220000**	**55000**	**679000**	**603000**
GENERAL	14265-44-2	Phosphate	µg/L	--	--	**300**	- -	1000 U	1000 U	1000 U	1000 U	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	1000 U	1000 U	**22000**	1000 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**1500**	- -	**2700**	**2300**	**3200**	**2900**	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**620**	- -	**5500**	**3900**	**4000**	**3800**	**3900**	**3700**
ANIONS	16887-00-6	Chloride	µg/L	--	--	**1500**	- -	1000 U	**1000**	**1000**	**1000**	1000 U	**6500**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	10 U	10 U	10 U	50 U	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	800 U	- -	**1700**	**1000**	**1000**	**2000**	1100 B	**6500**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.52 U	1.5 U	1.8 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.25 U	0.16 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.17 U	0.31 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.12 U	0.31 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.2 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.2 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.31 U	0.16 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.34 U	0.16 U	0.49 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.27 U	0.31 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	**3.31**	**3.7 J**	**2.4 J**	10 U	**5.7 J**	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**354**	**364**	**385**	**414**	**361 J**	**412**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	5 U	5 U	5 U	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**107000**	- -	**98100**	**111000**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**8.4**	**8.9 J**	**3.8 J**	**13.3**	**2.3 J**	**7.4 J**	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**1.6**	**2.7 J**	10 U	10 U	10 U	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**37200**	- -	**34600**	**38100**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	10 U	10 U	10 U	10 U	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	10 U	10 U	10 U	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**48800**	- -	**40700**	**44100**	- -	- -	- -	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	**0.34**	- -	5 U	5 U	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.52 U	1.2 U	1.4 U	0.29 U	0.2 U	0.19 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	0.66 U	- -	5 U	5 U	- -	- -	- -	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	0.06 U	- -	5 U	5 U	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	0.17 U	- -	5 U	5 U	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	**4660**	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])									
					Location		16-B			16-B				
					Sample ID	F06-16-A-GW-REG	H16B-010900	16-B-20001117	16-B-20001117-FD	16-B-20010522	16-B-20020603	16-B-20030519	H16C-010900	16C-052100
					Sample Depth (ft)	99.4 - 109.4	15.1 - 25.1	15.1 - 25.1	15.1 - 25.1	15.1 - 25.1	15.1 - 25.1	15.1 - 25.1	15.6 - 25.6	15.6 - 25.6
					Sample Date	9/7/2006	1/9/2000	11/17/2000	11/17/2000	5/22/2001	6/3/2002	5/19/2003	1/9/2000	5/21/2000
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**475000**	**281000**	**290000**	**270000**	**310000**	**300000**	**310000**	**242000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	100 U	**30**	10 U	10 U	10 U	**90**	**150**	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**575000**	**253000**	**29000**	**16000**	**60000**	**130000**	**38000**	**217000**	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	**89**	1000 U	1000 U	1000 U	1000 U	1000 U	**320**	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	200 U	1000 U	1000 U	1000 U	**24000**	1000 U	200 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	100 U	**300**	300 U	300 U	**400**	**500**	100 U	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**4100**	620 U	1000 U	1000 U	1000 U	1000 U	1000 U	**3700**	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**7100**	**2200**	**2000**	**1900**	**2000**	**2000**	**2000**	**1400**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	50 U	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	**780**	**300**	**290**	**280**	**310**	**130**	50 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**6800**	**28400**	**32000**	**26000**	**24000**	**22000**	**27000**	**9200**	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.03 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.05 U	0.17 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	- -	1 U	0.55 U	0.34 U	1.2 U	0.51 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.04 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.04 U	0.17 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.25 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.25 U	0.17 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.17 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.17 U	0.33 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.03 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.08 U	0.33 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.16 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.23 U	0.33 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	0.06 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.06 U	0.42 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.31 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.31 U	0.17 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	0.42 U	0.98 U	0.51 U	0.27 U	0.94 U	0.51 U	0.4 U	0.17 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.17 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.03 U	0.33 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	2.7 U	10 U	10 U	10 U	10 U	10 U	2.7 U	**8.6 J**
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**118**	**113 J**	**111**	**124 J**	**101 J**	**110 J**	**224**	**289**
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	0.64 U	**0.3 J**	**5**	5 U	5 U	5 U	0.64 U	**0.4 J**
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**67800**	**63800**	**62200**	**72500**	- -	- -	**64600**	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	1.2 U	**1.6 J**	**2.2**	10 U	10 U	10 U	**9.9**	**47.3**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	1.4 U	**1.6 J**	10 U	10 U	10 U	10 U	**3.5**	**9.1**
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**26000**	**24400**	**24100**	**27600**	- -	- -	**24300**	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.06 U	0.21 U	0.21 U	0.21 U	0.2 U	0.2 U	**1.1**	0.1 U
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	2.9 U	**1.1 J**	10 U	10 U	10 U	10 U	2.9 U	2.6 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	1.1 U	10 U	10 U	10 U	10 U	10 U	1.1 U	2.8 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**31800**	**28300**	**27600**	**15600**	- -	- -	**21200**	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	- -	0.34 U	5 U	5 U	5 U	- -	- -	0.34 U	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.15 U	1 U	0.55 U	0.27 U	0.94 U	0.51 U	0.07 U	0.17 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	***86***	**6**	**4**	5 U	- -	- -	0.66 U	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	- -	0.06 U	5 U	5 U	5 U	- -	- -	0.06 U	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	0.17 U	5 U	5 U	5 U	- -	- -	0.17 U	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	16-C-20001118	16-C-20010522	16-C-20020603	16-C-20030519	H16D-010900	16-D-20001117	16-D-20010521	16-D-20020603	16-D-20030519
					Location	16-C				16-D				
					Sample ID	16-C-20001118	16-C-20010522	16-C-20020603	16-C-20030519	H16D-010900	16-D-20001117	16-D-20010521	16-D-20020603	16-D-20030519
					Sample Depth (ft)	15.6 - 25.6	15.6 - 25.6	15.6 - 25.6	15.6 - 25.6	15 - 25	15 - 25	15 - 25	15 - 25	15 - 25
					Sample Date	11/18/2000	5/22/2001	6/3/2002	5/19/2003	1/9/2000	11/17/2000	5/21/2001	6/3/2002	5/19/2003
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**220000**	**250000**	**230000**	**240000**	**233000**	**240000**	**230000**	**240000**	**260000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	10 U	10 U	20 U	**150**	10 U	10 U	10 U	20 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**40000**	**45000**	**100000**	**26000**	**218000**	**26000**	**40000**	**110000**	**28000**
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	**330**	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	**1100**	1000 U	**24000**	1000 U	200 U	**1600**	1000 U	**23000**	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	**600**	300 U	100 U	**300**	**500**	**700**	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1200**	1000 U	1000 U	1000 U	620 U	1000 U	1000 U	1000 U	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	**1300**	**1000**	**1000**	**1000**	**1400**	**1200**	**2000**	**2000**	**2000**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**130**	**430**	**150**	**130**	50 U	**70**	**40**	**40**	**90**
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**8900**	**10000**	**8000**	**10000**	**34800**	**36000**	**35000**	**30000**	**36000**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.65 U	0.49 U	0.42 U	0.81 U	0.03 U	1.1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.65 U	0.62 U	0.52 U	0.81 U	- -	1.1 U	1.3 U	0.63 U	0.74 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.65 U	0.49 U	0.42 U	0.81 U	0.04 U	1.1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.65 U	0.49 U	0.42 U	0.81 U	0.25 U	1.1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.65 U	0.49 U	0.42 U	0.81 U	0.17 U	1.1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.65 U	0.49 U	0.42 U	0.81 U	0.03 U	1.1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.65 U	0.49 U	0.42 U	0.81 U	0.08 U	1.1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.65 U	0.49 U	0.42 U	0.81 U	0.06 U	1.1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.65 U	0.49 U	0.42 U	0.81 U	0.31 U	1.1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.61 U	0.49 U	0.42 U	0.81 U	0.24 U	1 U	1.1 U	0.51 U	0.74 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.65 U	0.49 U	0.42 U	0.81 U	0.03 U	1.1 U	1.1 U	0.51 U	0.74 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	10 U	10 U	10 U	2.7 U	10 U	10 U	10 U	10 U
METALS	7440-39-3	Barium	µg/L	2000	430	**143 J**	**170 J**	**145 J**	**150 J**	**120**	**105 J**	**109 J**	**114 J**	**108 J**
METALS	7440-43-9	Cadmium	µg/L	5	5	**0.8 J**	5 U	5 U	5 U	0.64 U	5 U	5 U	5 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	**52000**	**57100**	- -	- -	**64900**	**61900**	**59500**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**3 J**	**7 J**	**1.4 J**	**0.87 J**	5.2 U	**2 J**	**0.6 J**	10 U	**0.76 J**
METALS	7439-92-1	Lead	µg/L	15	18.05	**2.7 J**	10 U	10 U	**3.7 J**	**1.5**	10 U	**1.3 J**	10 U	**3.4 J**
METALS	7439-95-4	Magnesium	µg/L	--	45243	**18100**	**20300**	- -	- -	**23800**	**22200**	**21900**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	0.21 U	0.2 U	0.2 U	0.06 U	0.21 U	0.21 U	0.2 U	0.2 U
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	**1.8 J**	10 U	10 U	2.9 U	**1.1 J**	10 U	10 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	10 U	10 U	1.1 U	10 U	10 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	**15800**	**18400**	- -	- -	**17300**	**14900**	**16300**	- -	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	5 U	5 U	- -	- -	0.34 U	5 U	5 U	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.65 U	0.49 U	0.42 U	0.81 U	0.02 U	1.1 U	1.1 U	0.51 U	0.74 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	***13***	5 U	- -	- -	0.66 U	***25***	5 U	- -	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	5 U	5 U	- -	- -	**0.08**	5 U	5 U	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	5 U	5 U	- -	- -	0.17 U	5 U	5 U	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	16-E					JAW-53					
					Sample ID	H16E-010900	16-E-20001118	16-E-20010522	16-E-20020603	16-E-20030519	JAW-53-051700	JAW-53-20001113	JAW-53-20010607	JAW-53-20010706	JAW-53-20020603	JAW-53-20030520
					Sample Depth (ft)	45 - 55	45 - 55	45 - 55	45 - 55	45 - 55	8 - 18	8 - 18	8 - 18	8 - 18	8 - 18	8 - 18
					Sample Date	1/9/2000	11/18/2000	5/22/2001	6/3/2002	5/19/2003	5/17/2000	11/13/2000	6/7/2001	7/6/2001	6/3/2002	5/20/2003
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**											
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**456000**	**470000**	**480000**	**480000**	**490000**	- -	**140000**	- -	**240000**	**250000**	**260000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**290**	**250**	**260**	**360**	**330**	- -	10 U	- -	10 U	**10**	20 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**422000**	**48000**	**110000**	210000 U	**80000**	- -	**24000**	- -	**38000**	**110000**	**69000**
GENERAL	14265-44-2	Phosphate	µg/L	--	--	**490**	1000 U	1000 U	1000 U	1000 U	- -	1000 U	- -	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	**3100**	1000 U	**23000**	1000 U	- -	1000 U	- -	1000 U	**24000**	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	**600**	**600**	**400**	**700**	- -	300 U	- -	300 U	**600**	**400**
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	1000 U	1000 U	1000 U	1000 U	- -	**1400**	- -	1000 U	1000 U	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	**1600**	1000 U	**1000**	**1000**	**1000**	- -	**4200**	- -	**3000**	1000 U	**3000**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	10 U	50 U	**20**	50 U	- -	10 U	- -	60 U	10 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**25700**	**23000**	**22000**	**20000**	**25000**	- -	**8300**	- -	**9000**	**1000**	**10000**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.4 U	0.65 U	0.43 U	0.95 U	0.16 U	1.3 U	- -	0.84 U	0.57 U	0.7 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.4 U	0.81 U	0.53 U	0.95 U	- -	1.3 U	- -	1.1 U	0.71 U	0.7 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.4 U	0.65 U	0.43 U	0.95 U	0.16 U	1.3 U	- -	0.84 U	0.57 U	0.7 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.25 U	0.4 U	0.65 U	0.43 U	0.95 U	0.16 U	1.3 U	5 U	0.84 U	0.57 U	0.7 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.17 U	0.4 U	0.65 U	0.43 U	0.95 U	0.31 U	1.3 U	5 U	0.84 U	0.57 U	0.7 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.4 U	0.65 U	0.43 U	0.95 U	0.31 U	1.3 U	- -	0.84 U	0.57 U	0.7 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.14 U	0.4 U	0.65 U	0.43 U	0.95 U	0.31 U	1.3 U	- -	0.84 U	0.57 U	0.7 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.4 U	0.65 U	0.43 U	0.95 U	0.39 U	1.3 U	- -	0.84 U	0.57 U	0.7 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.31 U	0.4 U	0.65 U	0.43 U	0.95 U	16 U	1.3 U	5 U	0.84 U	0.57 U	0.7 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.3 U	0.38 U	0.65 U	0.43 U	0.95 U	0.16 U	1.2 U	- -	0.84 U	0.57 U	0.7 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.03 U	0.4 U	0.65 U	0.43 U	0.95 U	0.31 U	1.3 U	- -	0.84 U	0.57 U	0.7 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	**3.3**	10 U	10 U	4.3 U	10 U	3.2 U	10 U	- -	10 U	10 U	10 U
METALS	7440-39-3	Barium	µg/L	2000	430	**303**	**276**	**276**	**266 J**	**270**	**123**	**118 J**	- -	**117 J**	**101 J**	**109 J**
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	**0.8 J**	5 U	0.5 U	5 U	0.4 U	5 U	- -	5 U	5 U	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	**114000**	**116000**	**116000**	- -	- -	- -	**67500**	- -	**60500**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**52.2**	10 U	10 U	**1.7 J**	10 U	**1.8 J**	10 U	- -	10 U	10 U	10 U
METALS	7439-92-1	Lead	µg/L	15	18.05	**1.9**	10 U	10 U	**2.8 J**	10 U	**1.7 J**	10 U	- -	10 U	10 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	**41400**	**38100**	**39200**	- -	- -	- -	**22600**	- -	**21500**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.21 U	0.21 U	0.04 U	0.2 U	0.1 U	0.21 U	- -	0.21 U	0.2 U	0.2 U
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	10 U	10 U	2.8 U	10 U	2.6 U	10 U	- -	10 U	10 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	10 U	10 U	0.3 U	10 U	2.8 U	10 U	- -	10 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	**33300**	**26500**	**28200**	- -	- -	- -	**12000**	- -	**11300**	- -	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	0.34 U	5 U	5 U	- -	- -	10 U	5 U	- -	5 U	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.4 U	0.65 U	0.43 U	0.95 U	0.16 U	1.3 U	- -	0.84 U	0.57 U	0.7 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	0.66 U	5 U	5 U	- -	- -	10 U	***35***	- -	5 U	- -	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	0.06 U	5 U	5 U	- -	- -	- -	5 U	- -	5 U	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	0.17 U	5 U	5 U	- -	- -	10 U	5 U	- -	5 U	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	JAW-54						JAW-54		
					Sample ID	JAW-54-051700	JAW-54-20001119	JAW-54-20010523	JAW-54-20010523-FD	JAW-54-20020603	JAW-54-20020603-FD	JAW-54-20030521	JAW-54-20030521-FD	F04-GW-006
					Sample Depth (ft)	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25
					Sample Date	5/17/2000	11/19/2000	5/23/2001	5/23/2001	6/3/2002	6/3/2002	5/21/2003	5/21/2003	11/11/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	190000	170000	170000	110000	170000	180000	200000	180000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	10 U	10 U	10 U	20	10 U	20 U	20 U	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	38000	24000	21000	48000	74800	28000	33000	7800
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	1000 U	1000 U	1000	1000 U	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	1000 U	1000 U	25000	22000	1000 U	1000 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	300 U	300 U	300 U	500	500	300 U	300 U	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	1400	1400	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	10000	10000	11000	8000	8000	7000	8000	6000
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	300
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	250	300	300	460	470	390	380	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	31000	29000	31000	30000	29000	28000	30000	24000
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.5	2.1	3.1	3.1	7.6	7.7	9.6 J	9.1	15
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	14	14 J	15	8 J	8.1 J	5.5 J	5.4	5.8
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.17 U	0.91	0.81 U	0.47 U	0.56 U	0.84 U	0.74 U	0.36 U	0.68
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.17 U	1.3	0.81 U	0.47 U	1.3	1.2	1.2 J	1.1	1.2
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.34 U	0.74 U	0.81 U	0.47 U	0.56 U	0.84 U	0.74 U	0.36 U	0.16 JP
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	86	83	73	81	67 J	66 J	56	48	64 D
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	29	28	24	26	22 J	22 J	20	18	25
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1.7
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1.2 P
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	220	170	170	130	120	160	130	120	160 D
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.17 U	0.74 U	0.81 U	0.47 U	0.56 U	0.84 U	0.74 U	0.36 U	0.48 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	840	680	570	520	380 J	520	320	290	420 D
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.34 U	14	0.81 U	0.47 U	0.56 U	0.84 U	0.74 U	0.36 U	0.48 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.4 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U
METALS	7440-39-3	Barium	µg/L	2000	430	82.2	88.2 J	81.3 J	81	80.9 J	74.9 J	79.4 J	79.4	83.2 B
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	0.8 J	5 U	0.3	5 U	5 U	5 U	5 U	0.63 B
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	47800	42200	44800	- -	- -	- -	- -	39300
METALS	7440-47-3	Chromium	µg/L	100	31	1.8 U	10 U	0.5 J	10 U	10 U	10 U	10 U	10 U	1.1 B
METALS	7439-92-1	Lead	µg/L	15	18.05	1.7 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	18200	18000	18200	- -	- -	- -	- -	16000
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	45.1
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	0.21 U	0.21 U	0.21 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	209 BE
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	10 U	10 U	10 U	2.8 J	10 U	10 U	10 U	10 U
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	15400	16400	16600	- -	- -	- -	- -	14600 E
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	10 U	5 U	5 U	5 U	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.17 U	0.74 U	0.81 U	0.47 U	0.56 U	0.84 U	0.74 U	0.36 U	0.094 J
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	23	54	5 U	5 U	- -	- -	- -	- -	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	- -	5 U	5 U	5 U	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	10 U	5 U	5 U	5 U	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	0.51 J	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	6

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	JAW-54					JAW-55			
					Sample ID	F05-JAW-54-GW-REG	S06-JAW-54-GW-REG	S07-JAW-54-GW-FD	S07-JAW-54-GW-REG	S08-JAW-54-GW-REG	JAW-55-051700	JAW-55-20001117	JAW-55-20001117-FD	JAW-55-20010607
					Sample Depth (ft)	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25	10 - 25
					Sample Date	10/3/2005	4/14/2006	6/5/2007	6/5/2007	5/6/2008	5/17/2000	11/17/2000	11/17/2000	6/7/2001
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**190000**	**192000**	- -	- -	- -	- -	**260000**	**270000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	10 U	10 U	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**189000**	**176000**	- -	- -	- -	- -	**130000**	**120000**	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	1000 U	1000 U	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	1000 U	1000 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	**300**	**300**	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1000**	810 B	- -	- -	- -	- -	**1300**	**1300**	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	1500 B	**8800**	- -	- -	- -	- -	**2000**	**2000**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**550**	**560**	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	30 U	30 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**19200**	**25300**	- -	- -	- -	- -	**24000**	**25000**	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	**15.9**	**18.9**	- -	- -	- -	0.16 U	0.61 U	0.27 U	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**4.3**	**4.2**	- -	- -	- -	- -	0.61 U	0.27 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	**0.58**	**0.57**	- -	- -	- -	0.16 U	0.61 U	0.27 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	***0.7***	***0.79***	- -	- -	- -	0.16 U	0.61 U	0.27 U	5 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.19 U	- -	- -	- -	0.31 U	0.61 U	0.27 U	5 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***42.3***	***45.2***	- -	- -	- -	0.31 U	0.61 U	0.27 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***16.4***	***18.1***	- -	- -	- -	0.31 U	0.61 U	0.27 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**1.1**	**0.79**	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	**1.1**	**0.83**	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**112**	**124**	- -	- -	- -	**2.4**	**3.6**	**3.2**	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.19 U	- -	- -	- -	0.16 U	0.61 U	0.27 U	5 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***302***	***307***	***257***	***295***	***234***	0.16 U	0.57 U	0.26 U	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.19 U	- -	- -	- -	0.31 U	0.61 U	0.27 U	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	3.2 U	10 U	10 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	**123**	**157 J**	**154**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	0.4 U	5 U	**0.6**	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	**68500**	**74000**	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	**1.8 J**	**0.4 J**	**0.5**	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	1.9 U	1.6 U	10 U	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	**23300**	**24400**	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	0.1 U	0.21 U	0.21 U	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	2.6 U	10 U	10 U	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	2.8 U	10 U	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	**11200**	**10800**	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	- -	- -	- -	- -	- -	10 U	5 U	5 U	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.19 U	- -	- -	- -	0.16 U	0.61 U	0.27 U	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	10 U	***79***	***65***	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	- -	- -	- -	- -	- -	- -	5 U	5 U	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	10 U	5 U	5 U	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**3.87**	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	
					Sample ID	JAW-55-20010706
					Sample Depth (ft)	10 - 25
					Sample Date	7/6/2001
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95(1))**	
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**250000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**75000**
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2000**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**130**
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**24000**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.4 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.1 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**3.5**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	1.1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.1 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.1 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U
METALS	7440-39-3	Barium	µg/L	2000	430	**164 J**
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	**74900**
METALS	7440-47-3	Chromium	µg/L	100	31	**0.3 J**
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	**25500**
METALS	7439-96-5	Manganese	µg/L	430	580	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U
METALS	7440-09-7	Potassium	µg/L	--	2540	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U
METALS	7440-22-4	Silver	µg/L	130	10	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	**11400**
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	5 U
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	1.1 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	5 U
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	5 U
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	5 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -
VOLATILES	74828	Methane	µg/L	--	--	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	JAW-55		JAW-56					JAW-57	
					Sample ID	JAW-55-20020615	JAW-55-20030520	JAW-56-051700	JAW-56-20001117	JAW-56-20010614	JAW-56-20020616	JAW-56-20030521	JAW-57-20001117	JAW-57-20010616
					Sample Depth (ft)	10 - 25	10 - 25	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	15 - 25	15 - 25
					Sample Date	6/15/2002	5/20/2003	5/17/2000	11/17/2000	6/14/2001	6/16/2002	5/21/2003	11/17/2000	6/16/2001
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**300000**	**270000**	- -	**350000**	**150000**	**150000**	**200000**	**150000**	**130000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	20 U	- -	10 U	10 U	10 U	20 U	- -	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**130000**	**110000**	- -	**120000**	**40000**	**66000**	**22000**	**100000**	**120000**
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	- -	1000 U	1000 U	1000 U	1000 U	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	- -	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	- -	**300**	300 U	300 U	300 U	- -	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1200**	**1000**	- -	1000 U	**1600**	1000 U	1000 U	- -	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2000**	**3000**	- -	1000 U	1000 U	1000 U	1000 U	- -	**4000**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**80**	**50**	- -	**70**	**40**	10 U	50 U	- -	**1500**
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**24000**	**28000**	- -	**86000**	**37000**	**63000**	**41000**	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.62 U	0.68 U	0.16 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.78 U	0.68 U	- -	0.7 U	1.3 U	0.63 U	0.53 U	0.48 U	0.6 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.62 U	0.68 U	0.16 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.62 U	0.68 U	0.16 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.62 U	0.68 U	0.31 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.62 U	0.68 U	0.31 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.62 U	0.68 U	0.31 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**3 J**	**2.5 J**	0.39 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.62 U	0.68 U	0.16 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.62 U	**0.35 J**	0.16 U	0.66 U	1.1 U	0.51 U	0.53 U	0.45 U	0.48 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.62 U	0.68 U	0.31 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	10 U	2.4 U	10 U	10 U	10 U	10 U	**3.1 J**	10 U
METALS	7440-39-3	Barium	µg/L	2000	430	**144 J**	**163 J**	**82.7**	**87.1 J**	**69 J**	**64.6 J**	**76.5 J**	**69.8 J**	**62.5 J**
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	5 U	0.4 U	**0.3 J**	10 U	5 U	5 U	**0.4 J**	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	**52800**	**37700**	- -	- -	**46000**	**30700**
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	10 U	1.8 U	**0.7 J**	**0.5 J**	10 U	10 U	10 U	10 U
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	10 U	2.9 U	10 U	10 U	10 U	10 U	**1.6 J**	**4.9 J**
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	**17500**	**13500**	- -	- -	**15800**	**14100**
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.2 U	0.2 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	0.21 U	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	10 U	2.6 U	**1.3 J**	10 U	10 U	10 U	10 U	**2.4 J**
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	2.8 U	10 U	10 U	10 U	10 U	10 U	**0.4 J**
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	**15100**	**12500**	- -	- -	**12000**	**14100 J**
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	- -	- -	10 U	5 U	5 U	- -	- -	5 U	5 U
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.62 U	0.68 U	0.16 U	0.7 U	1.1 U	0.51 U	0.53 U	0.48 U	0.48 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	10 U	***8***	5 U	- -	- -	***24***	***40***
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	- -	- -	- -	5 U	5 U	- -	- -	5 U	5 U
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	10 U	5 U	5 U	- -	- -	5 U	5 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	JAW-57		JAW-77					L3-DP01		L3-DP01-18
					Sample ID	JAW-57-20020603	JAW-57-20030520	JAW-77-051700	JAW-77-20001025	JAW-77-20010616	JAW-77-20020616	JAW-77-20030519	L3-DP01-25	L3-DP01-52	L3-DP1-2530-0718
					Sample Depth (ft)	15 - 25	15 - 25	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	20 - 25	47 - 52	25 - 30
					Sample Date	6/3/2002	5/20/2003	5/17/2000	10/25/2000	6/16/2001	6/16/2002	5/19/2003	11/6/2002	11/6/2002	7/13/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**120000**	**120000**	- -	**150000**	**140000**	**140000**	**150000**	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	**20**	- -	**50**	10 U	10 U	**100**	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**85000**	- -	**21000**	**28000**	**62000**	**28000**	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	**23000**	1000 U	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**400**	**500**	- -	**400**	300 U	300 U	**600**	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	**1800**	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**4000**	**4000**	- -	**4700**	**6000**	**7000**	**7000**	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**2300**	**740**	- -	**190**	**340**	**290**	50 U	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**36000**	**35000**	- -	**35000**	- -	**29000**	**38000**	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.2 U	1.1 U	0.16 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	**0.2 J**
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.5 U	1.1 U	- -	0.94 U	0.75 U	1.1 U	0.4 U	0.29 U	0.36 U	0.12 UJ
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.2 U	1.1 U	0.16 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	0.12 UJ
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.2 U	1.1 U	0.16 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	0.12 UJ
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.2 U	1.1 U	0.31 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	0.12 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.2 U	1.1 U	0.31 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	0.12 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.2 U	1.1 U	0.31 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	0.12 UJ
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.24 UJ
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.12 UJ
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.2 U	1.1 U	0.39 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	**0.2 J**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	1.2 U	1.1 U	0.16 U	0.94 U	0.6 U	0.91 U	0.4 U	- -	- -	0.12 UJ
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.2 U	1.1 U	0.16 U	0.88 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	**0.058 J**
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.2 U	1.1 U	0.31 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	0.12 UJ
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	10 U	2.4 U	10 U	10 U	10 U	10 U	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**56.2 J**	**52.9 J**	**54.3**	**62.6 J**	**53.7 J**	**53.4 J**	**56.5 J**	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	***47.8***	5 U	0.4 U	**0.4 J**	10 U	5 U	5 U	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	**47800**	**39800**	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	10 U	1.8 U	**0.6 J**	10 U	10 U	10 U	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	10 U	3.2 U	**3.4 J**	**3.7 J**	10 U	10 U	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	**13500**	**13300**	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.2 U	0.2 U	0.1 U	0.21 U	0.21 U	0.2 U	0.2 U	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	10 U	2.6 U	10 U	**3.5 J**	10 U	10 U	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	2.8 U	**0.3 J**	10 U	10 U	10 U	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	**10100**	**10600**	- -	- -	- -	- -	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	- -	- -	10 U	5 U	5 U	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	1.2 U	1.1 U	0.16 U	0.94 U	0.6 U	0.91 U	0.4 U	0.29 U	0.36 U	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	10 U	***260***	***10***	- -	- -	- -	- -	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	- -	- -	- -	5 U	5 U	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	10 U	5 U	5 U	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	L3-DP02		L3-DP02-18	L3-DP03		L3-DP03-18	L3-DP04		L3-DP05		L3-DP06	
					Sample ID	L3-DP02-45	L3-DP02-13	L3-DP2-1520-0718	L3-DP03-25	L3-DP03-48	L3-DP3-3438-0718	L3-DP04-22	L3-DP04-45	L3-DP05-20	L3-DP05-60	L3-DP06-25	L3-DP06-52
					Sample Depth (ft)	40 - 45	8 - 13	15 - 20	20 - 25	43 - 48	34 - 38	17 - 22	40 - 45	15 - 20	55 - 60	20 - 25	47 - 52
					Sample Date	11/6/2002	11/25/2002	7/20/2018	11/6/2002	11/13/2002	7/20/2018	11/6/2002	11/6/2002	11/6/2002	11/6/2002	11/6/2002	11/6/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**												
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.1 U	0.3 U	**0.035 J**	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	0.22 UJ	- -	- -	0.22 UJ	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	0.11 UJ	- -	- -	0.11 UJ	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	- -	- -	**0.075 J**	- -	- -	0.11 UJ	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.1 U	0.3 U	0.11 UJ	0.81 U	0.7 U	0.11 UJ	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	1.1 U	0.3 U	- -	0.81 U	0.7 U	- -	0.6 U	0.69 U	0.48 U	0.36 U	0.39 U	0.44 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	L3-DP07		L3-DP08		L3-DP09		L3-DP10		L3-MW1		
					Sample ID	L3-DP07-18	L3-DP07-55	L3-DP08-25	L3-DP08-55	L3-DP09-18	L3-DP09-55	L3-DP10-25	L3-DP10-58	L3-MW1-20030506	F05-L3-MW1-GW-REG	S06-L3-MW1-GW-REG
					Sample Depth (ft)	13 - 18	50 - 55	20 - 25	50 - 55	13 - 18	50 - 55	20 - 25	53 - 58	45.2 - 55.2	45.2 - 55.2	45.2 - 55.2
					Sample Date	11/12/2002	11/19/2002	11/7/2002	11/7/2002	11/11/2002	11/13/2002	11/6/2002	11/7/2002	5/6/2003	10/5/2005	4/14/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**											
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**380000**	**393000**	**385000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	**200**	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**40000**	**356000**	**600000**
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1000 U	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1000 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	300 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1000 U	930 B	770 B
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**3000**	1000 U	**7500**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**210**	**270**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	**80**	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	**28000**	**22100**	**25000**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.2 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.2 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	- -	- -	- -	- -	- -	- -	- -	- -	0.57 U	0.2 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.22 U	**0.84 P**	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	0.21 U	0.55 U	0.57 U	0.2 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	**257**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	**86900**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	**31100**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	0.2 U	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	**0.36 J**	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	**28800**	- -	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.22 U	0.54 U	0.77 U	0.31 U	0.39 U	0.69 U	**0.55**	0.55 U	0.57 U	0.2 U	0.19 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	R	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	- -	- -	- -	R	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**0.89**	- -

Table 5.4-3. Detected Chemicals in Groundwater—Line 3

Iowa Army Ammunition Plant, Summary of Chemicals Detected in Groundwater: Site Line 3

					Location	L3-MW1		L3-MW2		L3-MW2	
					Sample ID	F06-L3-MW1-GW-REG	L3-MW2-20030506	F05-L3-MW2-GW-REG	S06-L3-MW2-GW-FD	S06-L3-MW2-GW-REG	F06-L3-MW2-GW-REG
					Sample Depth (ft)	45.2 - 55.2	39.2 - 49.2	39.2 - 49.2	39.2 - 49.2	39.2 - 49.2	39.2 - 49.2
					Sample Date	9/7/2006	5/6/2003	10/5/2005	4/13/2006	4/13/2006	9/7/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95(1))**						
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**413000**	**340000**	**363000**	**348000**	**350000**	**333000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**483000**	**40000**	**360000**	**433000**	**381000**	**339000**
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	1000 U	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	790 B	1000 U	820 B	810 B	590 B	640 B
ANIONS	16887-00-6	Chloride	µg/L	--	--	**7900**	**8000**	1000 U	**7200**	**7100**	**7500**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**110**	- -	**110**	**180**	**170**	90 B
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**25100**	**17000**	**11100**	**15300**	**15200**	**15600**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	- -	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	- -	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	10 U	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**179 J**	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	5 U	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**73600**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	10 U	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	10 U	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**25200**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.2 U	- -	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	**0.74 J**	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**30300**	- -	- -	- -	- -
SEMIVOLATILES	120-82-1	1,2,4-Trichlorobenzene	µg/L	70	--	- -	5 U	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.51 U	0.21 U	0.19 U	0.19 U	0.19 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	10 U	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	5 U	- -	- -	- -	- -
SEMIVOLATILES	84-66-2	Diethyl phthalate	µg/L	15000	--	- -	5 U	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	R	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	**1.57**	- -	- -	- -

Notes:

DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane
MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one
RDX = 1,3,5-trinitro-1,3,5-triazine
TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol
B = The analyte was detected in the associated method and/or calibration blank.
E = Sample result over the calibration range, considered an estimated result.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
P = Sample failed confirmation precision criteria.
R = The sample results are rejected due to serious deficiencies in the ability to analyze the sample and to meet the quality control criteria. The presence or absence of the analyte cannot be verified.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
-- = Not Analyzed
µg/L = micrograms per liter
Bold indicates the analyte was detected
Italics indicates the result exceeded screening criteria
Shading indicates the result exceeded screening criteria and background value, if applicable.
*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.
MCL = Maximum Contaminant Level
Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.
Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.
Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)
(1) UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.4-5. Data Groupings Used in the HHRA—Line 3

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Description	Sample Count
AOC_GW	Groundwater for all of Line 3	44
AOC_GW-CW	Shallow Groundwater (DTW ≤ 10 feet bgs) in trench/culvert	22
AOC_GW_RDX Plume	Groundwater samples collected from core of "RDX Plume" (1)	10

Note:

(1) Sample data used to calculate exposure point concentrations of COPCs

bgs = below ground surface

COPC = chemical of potential concern

DTW = depth to water

Table 5.4-6. Samples Used in the HHRA—Line 3

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW			WG	16-A	16-A-20030519	5/19/2003	99.4	109.4
AOC_GW			WG	16-A	F05-16-A-GW-REG	10/5/2005	99.4	109.4
AOC_GW			WG	16-A	S06-16-A-GW-REG	4/13/2006	99.4	109.4
AOC_GW			WG	16-A	F06-16-A-GW-REG	9/7/2006	99.4	109.4
AOC_GW	AOC_GW-CW		WG	16-B	16-B-20030519	5/19/2003	15.1	25.1
AOC_GW	AOC_GW-CW		WG	16-C	16-C-20030519	5/19/2003	15.6	25.6
AOC_GW	AOC_GW-CW		WG	16-D	16-D-20030519	5/19/2003	15	25
AOC_GW			WG	16-E	16-E-20030519	5/19/2003	45	55
AOC_GW	AOC_GW-CW		WG	JAW-53	JAW-53-20030520	5/20/2003	8	18
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	JAW-54	JAW-54-20030521	5/21/2003	10	25
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	JAW-54	F04-GW-006	11/11/2004	10	25
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	JAW-54	F05-JAW-54-GW-REG	10/3/2005	10	25
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	JAW-54	S06-JAW-54-GW-REG	4/14/2006	10	25
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	JAW-54	S07-JAW-54-GW-REG	6/5/2007	10	25
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	JAW-54	S08-JAW-54-GW-REG	5/6/2008	10	25
AOC_GW	AOC_GW-CW		WG	JAW-55	JAW-55-20030520	5/20/2003	10	25
AOC_GW	AOC_GW-CW		WG	JAW-56	JAW-56-20030521	5/21/2003	10	20
AOC_GW	AOC_GW-CW		WG	JAW-57	JAW-57-20030520	5/20/2003	15	25
AOC_GW	AOC_GW-CW		WG	JAW-77	JAW-77-20030519	5/19/2003	10	20
AOC_GW			WG	L3-DP01-18	L3-DP1-2530-0718	7/13/2018	25	30
AOC_GW			WG	L3-DP02-18	L3-DP2-1520-0718	7/20/2018	15	20
AOC_GW			WG	L3-DP03-18	L3-DP3-3438-0718	7/20/2018	34	38
AOC_GW			WG	L3-DP04	L3-DP04-22	11/6/2002	17	22
AOC_GW			WG	L3-DP04	L3-DP04-45	11/6/2002	40	45
AOC_GW			WG	L3-DP05	L3-DP05-20	11/6/2002	15	20
AOC_GW			WG	L3-DP05	L3-DP05-60	11/6/2002	55	60
AOC_GW			WG	L3-DP06	L3-DP06-25	11/6/2002	20	25
AOC_GW			WG	L3-DP06	L3-DP06-52	11/6/2002	47	52
AOC_GW			WG	L3-DP07	L3-DP07-18	11/12/2002	13	18
AOC_GW			WG	L3-DP07	L3-DP07-55	11/19/2002	50	55
AOC_GW			WG	L3-DP08	L3-DP08-55	11/7/2002	50	55
AOC_GW			WG	L3-DP08	L3-DP08-25	11/7/2002	20	25

Table 5.4-6. Samples Used in the HHRA—Line 3

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW			WG	L3-DP09	L3-DP09-18	11/11/2002	13	18
AOC_GW			WG	L3-DP09	L3-DP09-55	11/13/2002	50	55
AOC_GW			WG	L3-DP10	L3-DP10-25	11/6/2002	20	25
AOC_GW			WG	L3-DP10	L3-DP10-58	11/7/2002	53	58
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	L3-MW1	L3-MW1-20030506	5/6/2003	45.2	55.2
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	L3-MW1	F05-L3-MW1-GW-REG	10/5/2005	45.2	55.2
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	L3-MW1	S06-L3-MW1-GW-REG	4/14/2006	45.2	55.2
AOC_GW	AOC_GW-CW	AOC_GW_RDX Plume	WG	L3-MW1	F06-L3-MW1-GW-REG	9/7/2006	45.2	55.2
AOC_GW	AOC_GW-CW		WG	L3-MW2	L3-MW2-20030506	5/6/2003	39.2	49.2
AOC_GW	AOC_GW-CW		WG	L3-MW2	F05-L3-MW2-GW-REG	10/5/2005	39.2	49.2
AOC_GW	AOC_GW-CW		WG	L3-MW2	S06-L3-MW2-GW-REG	4/13/2006	39.2	49.2
AOC_GW	AOC_GW-CW		WG	L3-MW2	F06-L3-MW2-GW-REG	9/7/2006	39.2	49.2

Notes:

(1) The data were reduced such that when a normal and duplicate sample were available, the highest detected concentration among normal or duplicate samples was used when a chemical was detected in any sample. If both results were non-detect, the lowest reported detection limit (i.e., reporting limit) was used.

WG = groundwater

Table 5.5-1. Previous Investigations and Remedial Actions—Line 3A

Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Installation Assessment of IAAAP (USATHAMA, 1980)	1980	A records search was conducted to assess the use, storage, treatment, and disposal of toxic and hazardous materials at IAAAP regarding environmental quality.	Line 3A was constructed in 1942 and used for loading large shells and bombs. The principal explosives used at Line 3A were TNT, RDX, and Composition B. A follow-on preliminary survey was recommended to assess potential soil contamination and potential contaminant migration off the facility.
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	1991	A preliminary assessment was conducted for Line 3A to evaluate the potential for contamination and assess potential migration pathways and exposure potential if contamination were present.	The report concluded that the area is a potential source of contamination based on historical site activities, and if contamination is present it could be migrating through groundwater and surface water to the southwest and northeast. It was recommended that groundwater, surface water, soil, and sediment sampling be conducted to determine the extent of contamination.
Facility-wide Site Inspection (JAYCOR, 1992)	1991	Eleven soil, two sediment, and one surface water sample were collected and analyzed for metals, explosives, pesticides, PCBs, VOCs, and SVOCs.	The surface water sample contained explosives, the sediment samples contained explosives and metals, and 9 of the 11 soil samples contained explosives, metals, pesticides, and SVOCs above the evaluation criteria. It was recommended that Line 3A be further investigated in the Phase I RI to determine the extent of contamination at the site.
Facility-wide Phase I Remedial Investigation (JAYCOR, 1993a)	1992	Phase I RI sampling included surface water, soil, and soil gas sampling. • One surface water sample was collected from the same location as the SI surface water sample and analyzed for explosives and metals. • 201 explosives and 173 metals screening samples were collected in soil. • A soil gas survey was conducted around solvent storage Buildings 3A-03-1 and 3A-03-2. Twenty-five soil gas samples were collected to assess VOCs.	The surface water sample reported metals levels in the range of 10 to 100 µg/L and did not report detectable levels of explosives. Results of the metals and explosives soils screening indicated metals and explosives contamination at the melt buildings (3A-05-01 and 3A-05-02), immediately surrounding buildings and sumps, and the loading dock areas. The maximum depth of metals contamination was 3 feet bgs while the maximum depth of explosives contamination was 4 feet bgs. In soil gas, VOC levels were below the evaluation protocol of 5.0 µg/L at Building 3A-03-2. At Building 3A-03-1, VOCs were detected in 4 of the 16 sample locations. Groundwater sampling was proposed for Line 3A as Phase II of the RI.

Table 5.5-1. Previous Investigations and Remedial Actions—Line 3A
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Follow-on Remedial Investigation (JAYCOR, 1996)	1993–1995	During Phase II of the RI, five shallow (JAW-15, JAW-17, JAW-19, JAW-20,[a], and JAW-22) and three deep (JAW-16, JAW-18, and JAW-21) monitoring wells were installed around the Line 3A melt buildings. All wells were sampled and analyzed for explosives, metals, SVOCs, and VOCs. Soil samples were collected during the drilling of each well and analyzed for explosives, metals, SVOCs, and VOCs. During the 1995 follow-on sampling, two of the deep wells (JAW-16 and JAW-21) were sampled again and analyzed for metals. Ten soil samples were collected and analyzed for PCBs.	Explosives were reported in five wells: less than 10 µg/L in JAW-16 and JAW-19 and between 10 and 100 µg/L in JAW-20, JAW-17, and JAW-15. Metals, primarily lead and chromium, were reported above detection limits in all seven wells. Lead exceeded its MCL in JAW-16 and JAW-21 during the Phase II RI, but neither lead nor chromium were detected in these wells during the follow-on sampling. VOCs (TCE and chloroform) were detected in four groundwater samples during the Phase II sampling. None of the soil samples collected during the follow-on sampling reported PCBs above detection limits. The RI recommended semiannual compliance groundwater monitoring at Line 3A for explosives and metals for compliance with the hazardous waste management regulations for permitted facilities (40 CFR Part 264), specifically, Subpart F of these regulations, “Releases from Solid Waste Management Units.”
Periodic Groundwater Monitoring (multiple reports)	1994–2008	Periodic groundwater sampling was conducted at Line 3A. Permanent monitoring wells JAW-15, JAW-16, JAW-17, JAW-18, JAW-19, JAW-20, JAW-21, and JAW-22 were sampled multiple times and analyzed for explosives, metals, SVOCs, and VOCs, depending on the sampling event.	Only RDX was regularly detected above its MCL in groundwater, primarily in wells JAW-15, JAW-17, JAW-18, JAW-20, JAW-21, and JAW-22. Two additional explosives (2-Amino-4,6-DNT and 4-Amino-2,6-DNT) were detected above their MCLs in well JAW-22 during the 2000, 2003, and 2006 sampling events. During the last 2008 event, RDX was detected at a maximum concentration of 8.9 µg/L.
Supplemental Groundwater Remedial Investigation Report (MWH, 2001)	1997	One groundwater and five soil samples were collected from two soil borings in the vicinity of Building 3A-03-01 and analyzed for VOCs.	Freon 113 was detected in all soil samples. Other VOCs were detected at low concentrations at a depth of 4 feet in one of the borings. No VOCs were detected in the groundwater sample; therefore, no additional investigation was recommended at this location.
Record of Decision for Soils OU-1 (Harza, 1998)	1998	The Final ROD for OU-1 was issued to address contaminated soils at IAAAP. The ROD presented the selected remedial action for OU-1.	The selected remedy included excavation for soil contaminated with metals and explosives at Line 3A.

Table 5.5-1. Previous Investigations and Remedial Actions—Line 3A
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	2005	A comprehensive evaluation was conducted of all IAAAP sites and the four primary watersheds (Brush Creek, Spring Creek, Long Creek, and Skunk River) to identify data gaps and additional data needed to complete a feasibility study for surface water and groundwater at each of the IAAAP sites.	The work plan concluded that soil, surface water, and sediment had been adequately characterized. Monitoring data indicated two RDX plumes in groundwater were present in the shallow till at Line 3A. The reported noted that the southern extent of the groundwater plumes had not been established. Further investigation of soil was recommended as part of the OU-1 RD/RA, and up to two additional direct-push groundwater samples were recommended to verify that the plumes had not expanded or migrated.
Remedial Action for OU-1 Soils Phase 5, 7, and 8 Sites (Tetra Tech, 2009a; USACE-Baltimore, 2016)	2006	Approximately 1,436 cubic yards of metals- and explosives-contaminated soil was removed from 17 excavations to depths ranging from 1 to 6 feet bgs.	Confirmation sampling indicated that RDX concentrations above the OU-1 RG were left in place in two inaccessible areas: one south of the railroad tracks near Building 3A-08-1, and one north of a vacuum house north of Building 3A-10-5. Contaminated soil along the south wall of excavation 3 (L3A-03), north of Building 3A-10-5, could not be removed without undermining the foundation of a vacuum house. Contaminated soil along the south wall of excavation 9 (L3A-09), north of Building 3A-08-1, could not be removed without undermining the foundation of a loading platform.
OU-6 Supplemental Remedial Investigation (Tetra Tech, 2012a)	2006–2007	One temporary monitoring well, L3A-TTTW-001 (screened 4 to 24 feet bgs) was installed in 2006 and sampled in 2007 to delineate downgradient contamination downgradient of JAW-22. Groundwater samples were analyzed for explosives. The temporary well was abandoned shortly after it was sampled.	Only 2,4,6-TNT was detected in temporary well L3A-TTTW-001, below its site characterization PAL. The report concluded that the eastern RDX plume at Line 3A was considered horizontally defined by L3A-TTTW-001, and although the western plume was not delineated by a sampling point, it was considered horizontally delineated based on the similar concentrations and the extent of the eastern plume.
Explanation of Significant Differences for the Records of Decision Soils OU-1 (Leidos, 2018)	2018	Documented the addition of LUC s to the selected remedy for the soils ROD to provide overall protectiveness of human health and the environment.	The Explanation of Significant Differences changes will apply to soil at Line 3A.

Table 5.5-1. Previous Investigations and Remedial Actions—Line 3A
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
OU-1 Land Use Controls Implementation Plan (Leidos, 2019)	2019	Outlined the process for implementation and maintenance of LUCs as a component of the selected remedy for OU-1. Institutional controls will be used to restrict land use at OU-1 areas to military, commercial/industrial, agricultural, and permitted hunting and prohibit residential use. Engineering controls (fencing, signs) will be used to prevent general access to areas.	The scope of the LUCIP applies to Line 3A.

[a] While the 1996 RI identifies JAW-20 as a shallow overburden well and JAW-21 as a deep overburden well, it is likely these wells were mis-labelled and subsequent sampling reports have listed JAW-20 as a deep overburden well and JAW-21 as a shallow overburden well (MWH 2001; Tetra Tech 2014). During the 2018 RI sampling activities, JAW-20 was measured as a deep overburden monitoring well and JAW-21 was measured as a shallow overburden well.

Table 5.5-3. Line 3A Monitoring Well Construction

Iowa Army Ammunition Plant, Middletown, IA

Well Location	Screen Interval (feet bgs)	Filter Pack Interval (feet bgs)	Borehole Depth (feet bgs)	Well Casing Diameter (inches)	Top of Casing Elevation (feet amsl)
L3A-MW1A	10 to 30	7 to 30	30	2	712.12
L3A-MW1B	42.5 to 52.5	40 to 56	56	2	711.81
L3A-MW3A	15 to 25	13 to 25	25	2	705.67
L3A-MW3B	38 to 48	36 to 50	50	2	705.17
L3A-MW4A	10 to 20	8 to 20	20	2	710.58
L3A-MW4B	45 to 55	41.5 to 55	55	2	710.4
L3A-MW5A	10 to 20	8 to 20	20	2	709.75
L3A-MW5B	35 to 45	33 to 46	46	2	709.73
L3A-MW6A	10 to 25	8 to 25	25	2	713.39
L3A-MW6B	52.5 to 62.5	52.5 to 63.8	63.8	2	713.02
L3A-MW7	52 to 62	49.6 to 63	63	2	713.2
L3A-TW19-01	10 to 20	8 to 20	20	2	NM
L3A-TW19-02	10 to 20	8 to 20	20	2	NM
L3A-TW19-03	10 to 20	8 to 20	20	2	NM
L3A-TW19-04A	15 to 25	12 to 25	25	2	NM
L3A-TW19-04B	43 to 53	41 to 53	54	2	NM

Notes:

Borehole diameter was 8 inches for monitoring wells L3A-MW1A and -MW5A, 6 inches for monitoring wells L3A-MW1B, -MW3A, -MW3B, -MW4A, -MW4B, -MW5B, -MW6A, -MW6B, and -MW7, and 6-inches for temporary monitoring wells L3A-TW19-01, -02, -03, -04A, and -04B.

amsl = above mean sea level

bgs = below ground surface

NM = Not Measured

Table 5.5-4. Gauging Information—Line 3A

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval (ft btoc)	Depth to Water (ft btoc)	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)
JAW-15	8/13/2018	5-20	12.82	712.88	700.06
JAW-16	8/13/2018	43-58	25.75	713.07	687.32
JAW-17	8/13/2018	5-15	11.44	711.83	700.39
JAW-18	8/17/2018[a]	36-51	51.4[a]	711.74	660.34
JAW-19	8/13/2018	5-15	15	715.77	700.77
JAW-20	8/16/2018[b]	43-58[c]	41.16[b]	713.82	672.66
JAW-21	8/16/2018[b]	5-20[c]	11.00[b]	714.66	703.66
JAW-22	8/13/2018	5-20	12.9	713.57	700.67
L3A-MW1A	8/13/2018	10-30	12.72	712.12	699.4
L3A-MW1B	8/13/2018	42.5-52.5	12.91	711.812	698.902
L3A-MW3A	8/13/2018	15-25	11.12	705.679	694.559
L3A-MW3B	8/13/2018	36-46	18.9	705.179	686.279
L3A-MW4A	8/13/2018	10-20	10.75	710.585	699.835
L3A-MW4B	8/13/2018	45-55	48.29	710.405	662.115
L3A-MW5A	8/22/2018[a]	10-20	11.48[b]	709.759	698.279
L3A-MW5B	8/22/2018[a]	35-45	42.72[b]	709.739	667.019
L3A-MW6A	8/13/2018	10-25	10.2	713.392	703.192
L3A-MW6B	8/13/2018	52.5-62.5	38.2	713.028	674.828
L3A-MW7	8/13/2018	52-62	41.3	713.207	671.907

Notes:

ft = feet

btoc = below top of casing

amsl = above mean sea level

[a]Depth to water measured prior to purging on sample date, unable to open lock during gauging event on 8/13/2018

[b]Depth to water measured prior to purging on sample date, Do Not Enter signs due to testing area prohibited measurement during gauging event on 8/13/2018

[c]Screen intervals based on 2018 measurements. Do not match historical well installation information (JAWCOR 1996) but are consistent with recent reports (Harza 2001, Tetra Tech 2016)

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-15								
					Sample ID	JAW-15-051700	JAW-15-20001115	JAW-15-20010521	JAW-15-20020615	JAW-15-20031118	F05-JAW-15-GW-REG	S06-JAW-15-GW-REG	F06-JAW-15-GW-REG	S07-JAW-15-GW-REG
					Sample Depth (ft)	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20
					Sample Date	5/15/2000	11/15/2000	5/21/2001	6/15/2002	11/18/2003	10/3/2005	4/24/2006	9/8/2006	6/7/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**230000**	**250000**	**290000**	**230000**	**344000**	**213000**	**223000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	10 U	10 U	**220**	**30**	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**62000**	**65000**	**130000**	- -	**391000**	**248000**	**308000**	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	**1400**	1000 U	1000 U	1000 U	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	300 U	**600**	**400**	300 U	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	1000 U	**1100**	**2000**	**10000**	970 B	**1500**	950 B	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	**11000**	**4000**	**2000**	**6000**	**3500**	**6800**	**9100**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	**3600**	***40300***	**1300**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	**110**	**200**	**280**	**510**	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	**98000**	**69000**	**72000**	**56000**	**44000**	**90400**	**43400**	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.16 U	1.2 U	0.88 U	0.64 U	0.71 U	0.19 U	0.21 U	0.19 U	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	**0.87 J**	**0.64**	0.79 U	**0.69 J**	**0.85**	**0.17 J**	**0.87**	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.16 U	1.2 U	0.88 U	0.64 U	0.71 U	0.19 U	0.21 U	0.19 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.16 U	1.2 U	0.88 U	0.64 U	0.71 U	0.19 U	0.21 U	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.31 U	1.2 U	0.88 U	0.64 U	0.71 U	0.19 U	0.21 U	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.31 U	1.2 U	0.88 U	0.64 U	0.71 U	**0.15 J**	0.21 U	**0.13 J**	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.78 U	1.2 U	0.88 U	0.64 U	0.71 U	0.19 U	0.21 U	0.19 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	0.19 U	0.21 U	0.19 U	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	0.19 U	0.21 U	0.19 U	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**2.5**	**3**	**3.6**	**3.7 J**	**2.5**	**3.7**	**1.9**	**3.4**	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.16 U	1.2 U	0.88 U	0.64 U	0.71 U	0.19 U	0.21 U	0.19 U	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***11***	***31***	***14***	***9.6***	***29***	***28.1***	***6.8***	***27.3***	***11.2***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.31 U	1.2 U	0.88 U	0.64 U	0.71 U	0.19 U	0.21 U	0.19 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**120**	**109 J**	**114 J**	**119 J**	**110 J**	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.5 U	**0.4 J**	**0.3 J**	5 U	5 U	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**64500**	**70000**	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**2.2 J**	**1.9 J**	10 U	10 U	**1.3 J**	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	2.5 U	**2.5 J**	10 U	10 U	10 U	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**25000**	**27600**	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	**5.7**	**2.1 J**	**8.1 J**	**5.9 J**	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**18300**	**23800**	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	0.5 U	- -	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-15			JAW-16					
					Sample ID	S08-JAW-15-GW-REG	JAW-15-0818	JAW-F15-0818	JAW-16-051800	JAW-16-20001117	JAW-16-20010522	JAW-16-20020616	JAW-16-20031119	JAW-16-0818
					Sample Depth (ft)	5 - 20	5 - 20	5 - 20	43 - 58	43 - 58	43 - 58	43 - 58	43 - 58	43 - 58
					Sample Date	5/9/2008	8/17/2018	8/17/2018	5/18/2000	11/17/2000	5/22/2001	6/16/2002	11/19/2003	8/16/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	**380000**	**400000**	**400000**	**400000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	**30**	10 U	10 U	**30**	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	**65000**	**160000**	**180000**	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	300 U	300 U	300 U	300 U	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	30 U	**30**	10 U	50 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	**5600**	**5000**	**5000**	**5000**	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	0.1 U	0.1 U	0.18 U	0.39 U	1.2 U	0.87 U	0.29 U	0.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	**0.48 J**	**0.47 J**	- -	0.39 U	1.5 U	1.1 U	0.29 U	0.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	0.1 U	0.1 U	0.18 U	0.39 U	1.2 U	0.87 U	0.29 U	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	0.1 U	0.1 U	0.18 U	0.39 U	1.2 U	0.87 U	0.29 U	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	0.1 U	0.1 U	0.36 U	0.39 U	1.2 U	0.87 U	0.29 U	0.1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	0.1 U	0.1 U	0.36 U	0.39 U	1.2 U	0.87 U	0.29 U	0.1 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	- -	0.2 U	0.21 U	0.91 U	0.39 U	1.2 U	0.87 U	0.29 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	**0.2 J**	**0.22 J**	- -	- -	- -	- -	- -	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.1 U	0.1 U	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	**2.7**	**3**	0.45 U	0.39 U	1.2 U	0.87 U	0.29 U	0.1 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	- -	0.1 U	0.1 U	0.18 U	0.39 U	1.2 U	0.87 U	0.29 U	0.1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***3.9***	***14***	***14***	0.18 U	0.37 U	1.2 U	0.87 U	0.29 U	0.1 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	- -	0.1 U	0.1 U	0.36 U	0.39 U	1.2 U	0.87 U	0.29 U	0.1 U
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	**436**	**385**	**423**	**372 J**	**434**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	0.4 U	5 U	5 U	5 U	5 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	**99100**	**101000**	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	**8 J**	**0.7 J**	10 U	**4.7 J**	**2.3 J**	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	3.7 U	10 U	10 U	**1.6 J**	10 U	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	**25300**	**25800**	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	2.6 U	**1.4 J**	10 U	**2.3 J**	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	**18700**	**19300**	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-17								
					Sample ID	JAW-17-051700	JAW-17-20001115	JAW-17-20010521	JAW-17-20020605	JAW-17-20031117	JAW-17-20031117-FD	F05-JAW-17-GW-REG	S06-JAW-17-GW-REG	F06-JAW-17-GW-REG
					Sample Depth (ft)	5 - 15	5 - 15	5 - 15	5 - 15	5 - 15	5 - 15	5 - 15	5 - 15	5 - 15
					Sample Date	5/17/2000	11/15/2000	5/21/2001	6/5/2002	11/17/2003	11/17/2003	10/3/2005	4/24/2006	9/8/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**260000**	**220000**	**250000**	**300000**	**300000**	**393000**	**282000**	**270000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	10 U	10 U	**20**	20 U	20 U	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**45000**	**40000**	**110000**	- -	- -	**447000**	**512000**	**448000**
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	1000 U	1000 U	**24000**	1000 U	1000 U	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	300 U	**700**	300 U	**900 J**	**300 J**	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	1000 U	**1700**	**1000**	1000 U	1000 U	710 B	700 B	600 B
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	**7700**	**18000**	**9000**	**9000**	**9000**	**9600**	**9800**	**11200**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	64 B	**1100**	**800**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	**170**	**1100**	**170**	50 U	**70**	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	**78000**	**80000**	**81000**	**94000**	**100000**	**106000**	**129000**	**93600**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.4 U	1.2 U	0.47 U	0.86 U	1.4 U	0.65 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	**1.4**	**1.1**	**1.3 J**	**1.4**	**1.3**	**1.2**	**0.92**	**1.3**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.4 U	1.2 U	0.47 U	0.86 U	1.4 U	0.65 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.4 U	1.2 U	0.47 U	0.86 U	1.4 U	0.65 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.79 U	1.2 U	0.47 U	0.86 U	1.4 U	0.65 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.79 U	1.2 U	0.47 U	0.86 U	1.4 U	0.65 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	2 U	1.2 U	0.47 U	0.86 U	1.4 U	0.65 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	**0.63**	**0.36**	**0.54**
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	**0.47**	**0.3**	**0.23**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**3.7**	**6.1**	**4.8**	**5.3 J**	**6.4**	**5.8**	**6.9**	**4.5**	**6.9**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.4 U	1.2 U	0.47 U	0.86 U	1.4 U	0.65 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***8.1***	***13***	***9.5***	***14***	***18***	***17***	***14***	***8.8***	***13.7***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.79 U	1.2 U	0.47 U	0.86 U	1.4 U	0.65 U	0.2 U	0.19 U	0.19 U
METALS	7440-39-3	Barium	µg/L	2000	430	**101**	**110 J**	**111 J**	**98.2 J**	**129 J**	**129 J**	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	**0.3 J**	5 U	5 U	5 U	5 U	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**72600**	**71200**	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	1.8 U	**0.7 J**	10 U	10 U	10 U	10 U	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	1.7 U	**1.6 J**	**1.8 J**	10 U	10 U	10 U	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**36200**	**37300**	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	**3 J**	10 U	10 U	10 U	10 U	10 U	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**10900**	**13000**	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	**0.54**	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-17				JAW-18					
					Sample ID	S07-JAW-17-GW-REG	S08-JAW-17-GW-FD	S08-JAW-17-GW-REG	JAW-17-0818	JAW-18-051700	JAW-18-20010521	JAW-18-20020605	JAW-18-20040616	S06-JAW-18-GW-REG	L3A-JAW-18-0818
					Sample Depth (ft)	5 - 15	5 - 15	5 - 15	5 - 15	36 - 51	36 - 51	36 - 51	36 - 51	36 - 51	36 - 51
					Sample Date	6/8/2007	5/9/2008	5/9/2008	8/17/2018	5/17/2000	5/21/2001	6/5/2002	6/16/2004	4/24/2006	8/30/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	**358000**	**330000**	**320000**	**290000**	**288000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	200 U	**10**	10 U	40 U	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	**38400**	**55000**	**140000**	**90000**	**462000**	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	1000 U	1000 U	**23000**	1000 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	200 U	**400**	300 U	1000 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	**580**	1000 U	1000 U	1000 U	500 U	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	**3000**	**7000**	**6000**	**4000**	**7500**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	**940**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	**1.2**	**1100**	**420**	**520**	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	**11900**	**44000**	**56000**	**58000**	**59500**	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	- -	- -	0.1 U	0.17 U	0.7 U	0.94 U	0.48 U	0.19 U	0.1 UJ
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	**5.3**	- -	0.87 U	1.2 U	**0.34 J**	**0.42**	**1 J**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	- -	- -	0.1 U	0.17 U	0.7 U	0.94 U	0.48 U	0.19 U	0.1 UJ
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	- -	- -	0.1 U	0.17 U	0.7 U	0.94 U	0.48 U	0.19 U	0.1 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	- -	- -	0.1 U	0.34 U	0.7 U	0.94 U	0.48 U	0.19 U	0.1 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	- -	- -	**1.1**	0.34 U	0.7 U	0.94 U	0.48 U	0.19 U	0.1 UJ
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	- -	- -	- -	0.2 U	0.84 U	0.7 U	0.94 U	0.48 U	0.19 U	0.21 UJ
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	**0.48 J**	- -	- -	- -	- -	**0.15 J**	**0.14 J**
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	**0.74 J**	- -	- -	- -	- -	**0.19**	**0.88 J**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	- -	**16**	**0.55**	**1.6**	**2**	**2.9**	**3.1**	**6.4 J**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	- -	- -	- -	0.1 U	0.17 U	0.7 U	0.94 U	0.48 U	0.19 U	0.1 UJ
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***12.8***	***8.9***	***8.6***	***160***	0.17 U	**1.1**	***5.8***	***4.2***	***3.5***	***100 J***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	- -	- -	- -	0.1 U	0.34 U	0.7 U	0.94 U	0.48 U	0.19 U	0.1 UJ
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	**379**	**307**	**201 J**	**169 J**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	0.4 U	5 U	5 U	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	**94300**	**92000**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	1.8 U	10 U	**0.72 J**	10 U	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	2.5 U	**1.2 J**	10 U	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	**35900**	**39200**	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	2.6 U	**3.4 J**	10 U	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	**15700**	**13200**	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-19							JAW-20		
					Sample ID	JAW-19-051700	JAW-19-20001116	JAW-19-20010521	JAW-19-20020605	JAW-19-20031118	S06-JAW-19-GW-REG	JAW-19-0818	JAW-20-051700	JAW-20-20001119	JAW-20-20010524
					Sample Depth (ft)	5 - 15	5 - 15	5 - 15	5 - 15	5 - 15	5 - 15	5 - 15	5 - 20	5 - 20	5 - 20
					Sample Date	5/17/2000	11/16/2000	5/21/2001	6/5/2002	11/18/2003	4/24/2006	8/16/2018	5/17/2000	11/19/2000	5/24/2001
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**299000**	**320000**	**300000**	**310000**	**310000**	**230000**	- -	- -	**360000**	**360000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	200 U	10 U	10 U	10 U	20 U	- -	- -	- -	**20**	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**61300**	**82000**	**620000**	**140000**	- -	**408000**	- -	- -	**88000**	**68000**
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	**1000**	1000 U	**23000**	1000 U	- -	- -	- -	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**220**	300 U	**600**	300 U	300 U	- -	- -	- -	300 U	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1000**	1000 U	1000 U	**1000**	1000 U	**1400**	- -	- -	1000 U	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2100**	**4200**	**2000**	**1000**	**3000**	**7200**	- -	- -	**2100**	**2000**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	***16900***	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**0.25**	**520**	**270**	**70**	**530**	- -	- -	- -	**1800**	**2200**
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**50800**	**35000**	**46000**	**33000**	**22000**	**54500**	- -	- -	**14000**	**14000**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.17 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.1 U	0.16 U	0.6 U	0.95 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	0.96 U	0.86 U	1.2 U	0.86 U	0.19 U	0.1 U	- -	0.6 U	1.2 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.17 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.1 U	0.16 U	0.6 U	0.95 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.17 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.1 U	0.16 U	0.6 U	0.95 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.35 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.1 U	0.31 U	0.6 U	0.95 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.35 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.1 U	0.31 U	0.6 U	0.95 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.87 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.2 U	0.78 U	0.6 U	0.95 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	0.19 U	0.2 U	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	0.19 U	0.1 U	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.44 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.1 U	0.39 U	0.6 U	0.95 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.17 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.1 U	0.16 U	0.6 U	0.95 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.17 U	0.9 U	0.69 U	0.94 U	0.86 U	**0.08 J**	**0.084 J**	0.16 U	**0.9**	**0.76**
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.35 U	0.96 U	0.69 U	0.94 U	0.86 U	0.19 U	0.1 U	0.31 U	0.6 U	0.95 U
METALS	7440-39-3	Barium	µg/L	2000	430	**121**	**119 J**	**127 J**	**111 J**	**119 J**	- -	- -	**347**	**323**	**344**
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	**0.4 J**	5 U	5 U	5 U	- -	- -	0.4 U	**1.1 J**	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	**77000**	**73800**	**80200**	- -	- -	- -	- -	- -	**94900**	**86600**
METALS	7440-47-3	Chromium	µg/L	100	31	1.8 U	**0.9 J**	**0.3 J**	10 U	10 U	- -	- -	1.8 U	10 U	**0.8 J**
METALS	7439-92-1	Lead	µg/L	15	18.05	1.9 U	10 U	10 U	10 U	10 U	- -	- -	1.7 U	**1.7 J**	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	**35000**	**32700**	**36300**	- -	- -	- -	- -	- -	**33300**	**32800**
METALS	7782-49-2	Selenium	µg/L	50	10	**5.4**	**3.1 J**	**7 J**	**3.2 J**	**4.1 J**	- -	- -	2.6 U	10 U	**2.4 J**
METALS	7440-23-5	Sodium	µg/L	--	42581	**19700**	**13800**	**16300**	- -	- -	- -	- -	- -	**13100**	**13400**
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-20							
					Sample ID	JAW-20-20020615	JAW-20-20031117	F05-JAW-20-GW-REG	S06-JAW-20-GW-REG	F06-JAW-20-GW-REG	S07-JAW-20-GW-REG	S08-JAW-20-GW-REG	JAW-20-0818
					Sample Depth (ft)	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20
					Sample Date	6/15/2002	11/17/2003	1/29/2006	4/9/2006	9/11/2006	6/8/2007	5/9/2008	8/16/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**360000**	- -	**375000**	**375000**	**376000**	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**160000**	- -	**401000**	**532000**	**408000**	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	- -	680 B	530 B	500 U	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2000**	- -	**2000**	**7200**	**7900**	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	**2300**	**2100**	**1700**	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**2300**	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**9000**	- -	**14300**	**14000**	**15800**	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.64 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	0.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.79 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	0.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.64 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.64 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.64 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	0.1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.64 U	1.6 U	**0.16 J**	0.19 U	0.19 U	- -	- -	**0.32**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.64 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	0.19 U	0.19 U	0.19 U	- -	- -	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	0.19 U	0.19 U	0.19 U	- -	- -	0.1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.64 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	**0.038 J**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.64 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	0.1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	**1.8**	1.6 U	***2.2***	**2**	**1.3**	***2.5***	***2.3***	***5.2***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.64 U	1.6 U	0.19 U	0.19 U	0.19 U	- -	- -	0.1 U
METALS	7440-39-3	Barium	µg/L	2000	430	**345 J**	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	**2.6 J**	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	0.5 U	0.5 U	- -	- -	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, , Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-21							
					Sample ID	JAW-21-20001118	JAW-21-20010524	JAW-21-20020615	JAW-21-20031117	F05-JAW-21-GW-REG	S06-JAW-21-GW-REG	F06-JAW-21-GW-REG	S07-JAW-21-GW-REG
					Sample Depth (ft)	43 - 58	43 - 58	43 - 58	43 - 58	43 - 58	43 - 58	43 - 58	43 - 58
					Sample Date	11/18/2000	5/24/2001	6/15/2002	11/17/2003	1/29/2006	4/9/2006	9/10/2006	6/8/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**190000**	**170000**	**180000**	**200000**	**190000**	**178000**	**184000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**30**	10 U	10 U	20 U	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**65000**	**45000**	**79000**	- -	**220000**	**207000**	**201000**	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	300 U	1100 U	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	850 B	**780 J**	520 B	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	**6000 J**	**6600**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	**930**	**1200**	**650**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**920**	**1100**	**980**	**1200**	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**32000**	**36000**	**32000**	**35000**	**37300**	**32400**	**39100**	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.81 U	1.1 U	0.52 U	0.87 U	0.2 U	0.2 U	0.2 U	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.81 U	**0.7 J**	**0.37 J**	0.87 U	**0.1 J**	**0.14 J**	**0.1 J**	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.81 U	1.1 U	0.52 U	0.87 U	**0.13 J**	**0.15 J**	0.2 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.81 U	1.1 U	0.52 U	0.87 U	0.2 U	0.2 U	0.2 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.81 U	1.1 U	0.52 U	0.87 U	0.2 U	0.2 U	0.2 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.81 U	1.1 U	0.52 U	0.87 U	**0.061 J**	0.2 U	0.2 U	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.81 U	1.1 U	0.52 U	0.87 U	0.2 U	0.2 U	0.2 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	0.2 U	0.2 U	0.2 U	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	0.2 U	0.2 U	0.2 U	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**1**	**0.95 J**	**1.8 J**	**0.56 J**	**0.32**	**0.55**	**0.27**	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.81 U	1.1 U	0.52 U	0.87 U	0.2 U	0.2 U	0.2 U	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***8.8***	***10***	***12***	***6.2***	***3.3***	***4.6***	***3.2***	***2.4***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.81 U	1.1 U	0.52 U	0.87 U	0.2 U	0.2 U	0.2 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**82.1 J**	**75.7 J**	**75.1 J**	**86.4 J**	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	**0.6 J**	5 U	5 U	5 U	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**49200**	**43800**	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	**0.6 J**	10 U	10 U	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**1.8 J**	10 U	10 U	10 U	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**21600**	**20900**	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	**6.1 J**	**5.8 J**	**6.7 J**	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**9710**	**9500**	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	0.5 U	0.5 U	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-21		JAW-22					
					Sample ID	S08-JAW-21-GW-REG	JAW-21-0818	JAW-22-20001117	JAW-22-20010521	JAW-22-20020605	JAW-22-20031118	F05-JAW-22-GW-REG	S06-JAW-22-GW-REG
					Sample Depth (ft)	43 - 58	43 - 58	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20	5 - 20
					Sample Date	5/9/2008	8/16/2018	11/17/2000	5/21/2001	6/5/2002	11/18/2003	1/29/2006	4/9/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	**390000**	**350000**	**360000**	**390000**	**385000**	**280000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	10 U	10 U	10 U	20 U	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	**75000**	**1100000**	**160000**	- -	**455000**	**428000**
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	1000 U	1000 U	**24000**	1000 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	**300**	**700**	300 U	**500**	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	**1200**	**1100**	**1200**	**1200**	**1900**	**3600**
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	**11000**	**6000**	**7000**	**52560**	**21800**	**13800**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	**3600**	***11800***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	**250**	**250**	**430**	**690**	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	**62000**	**150000**	**88000**	**118990**	**147000**	**254000**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	- -	0.1 U	0.35 U	0.61 U	0.99 U	1.8 U	0.2 U	0.19 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	**0.16 J**	**9.9**	**0.38**	1.2 U	**12**	**0.48**	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	- -	0.1 U	0.35 U	0.61 U	0.99 U	1.8 U	0.2 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	- -	0.1 U	0.35 U	0.61 U	0.99 U	1.8 U	0.2 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	- -	0.1 U	***2.4***	0.61 U	0.99 U	***3.9***	**0.098 J**	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	- -	0.1 U	***3.9***	0.61 U	0.99 U	***4.3***	**0.1 J**	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	- -	0.2 U	0.35 U	0.61 U	0.99 U	1.8 U	0.2 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	0.2 U	- -	- -	- -	- -	**0.32**	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.1 U	- -	- -	- -	- -	**0.22**	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	**0.5**	**17**	**0.48**	0.99 U	**36**	**2.3**	**3.2**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	- -	0.1 U	0.35 U	0.61 U	0.99 U	1.8 U	0.2 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***3.3***	***5.5***	***180***	***5.1***	***3.7***	***250***	***11.6***	**0.78**
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	- -	0.1 U	0.35 U	0.61 U	0.99 U	1.8 U	0.2 U	0.19 U
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	**206**	**861**	**154 J**	**178 J**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	10 U	5 U	5 U	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	**112000**	**116000**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	**1.5 J**	**0.8 J**	10 U	**0.85 J**	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	10 U	10 U	10 U	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	**45300**	**49900**	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	**1.9 J**	**6.2 J**	**3.3 J**	**3.8 J**	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	**9900**	**13800**	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.5 U	0.5 U

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, , Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	JAW-22				L3A-MW1A	L3A-MW1B	L3A-MW3A	L3A-MW3B	L3A-MW4A	L3A-MW4B
					Sample ID	F06-JAW-22-GW-REG	S07-JAW-22-GW-REG	S08-JAW-22-GW-REG	JAW-22-0818	L3A-MW1A-0818	L3A-MW1B-0818	L3A-MW3A-0818	L3A-MW3B-0818	L3A-MW4A-0818	L3A-MW4B-0818
					Sample Depth (ft)	5 - 20	5 - 20	5 - 20	5 - 20	10 - 30	42.5 - 52.5	15 - 25	36 - 46	10 - 20	45 - 55
					Sample Date	9/10/2006	6/7/2007	5/9/2008	8/16/2018	8/22/2018	8/21/2018	8/22/2018	8/22/2018	8/22/2018	8/21/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**368000**	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**401000**	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1100**	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**35000**	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**690**	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**77500**	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	**0.12 J**	- -	- -	0.1 U	0.1 U	0.1 U	0.1 U	**0.036 J**	0.1 U	0.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**9.5**	- -	- -	**2.3**	0.1 U	0.1 U	0.1 U	0.11 U	**0.23 J**	0.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	- -	- -	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	**0.099 J**	- -	- -	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***4.3***	- -	- -	**0.97**	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***4***	- -	- -	**0.85**	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.1 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	- -	- -	0.2 U	0.21 U	0.2 U	0.2 U	0.21 U	0.21 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**9.4**	- -	- -	**1.8**	0.21 U	0.2 U	0.2 U	0.21 U	**0.18 J**	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	**5**	- -	- -	**1.2**	0.1 U	0.1 U	0.1 U	0.11 U	**0.058 J**	0.1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**41.5**	- -	- -	**16**	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.1 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	- -	- -	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***251***	***13.5***	**1.7**	***75***	0.1 U	0.1 U	0.1 U	0.11 U	***5.1***	**0.3**
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	- -	- -	0.1 U	**0.12 J**	0.1 U	0.1 U	0.11 U	0.1 U	0.1 U
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

					Location	L3A-MW5A	L3A-MW5B	L3A-MW6A	L3A-MW6B	L3A-MW7	L3A-TTTW-001	L3A-TW19-01	L3A-TW19-02
					Sample ID	L3A-MW5A-0818	L3A-MW5B-0818	L3A-MW6A-0818	L3A-MW6B-0818	L3A-MW7-0818	L3A-TTTW-001	L3A-TW19-01-1020-0419	L3A-TW19-02-1020-0419
					Sample Depth (ft)	10 - 20	35 - 45	10 - 25	52.5 - 62.5	52 - 62	4 - 24	10 - 20	10 - 20
					Sample Date	8/22/2018	8/22/2018	8/29/2018	8/29/2018	8/30/2018	2/10/2007	4/28/2019	4/27/2019
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.1 U	0.1 U	0.1 U	0.1 U	0.099 U	0.2 U	0.42 U	0.42 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.1 U	0.1 U	0.1 U	0.1 U	0.099 U	- -	0.31 U	0.31 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.1 U	0.1 U	0.1 U	0.1 U	0.099 U	**0.58**	0.42 U	0.42 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.1 U	0.1 U	0.1 U	0.1 U	0.099 U	0.2 U	0.21 U	0.21 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.1 U	0.1 U	0.1 U	0.1 U	0.099 U	0.2 U	0.13 U	0.13 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.1 U	0.1 U	0.1 U	0.1 U	0.099 U	0.2 U	0.13 U	0.13 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.2 U	0.21 U	0.2 U	0.2 U	0.2 U	0.42 U	0.42 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.2 U	0.2 U	0.21 U	0.2 U	0.2 U	- -	0.27 U	0.26 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.1 U	0.1 U	0.1 U	0.1 U	0.099 U	- -	0.27 U	0.26 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.1 U	0.1 U	**0.12 J**	0.1 U	0.099 U	0.2 U	0.21 U	0.21 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.1 U	0.1 U	0.1 U	0.1 U	0.099 U	0.2 U	0.21 U	**0.14 J**
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***2.6 J***	**0.13 J**	0.1 U	0.1 U	0.099 U	0.2 U	0.42 U	0.42 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.1 U	0.1 U	**0.16 J**	0.1 U	0.099 U	0.2 U	0.21 U	0.21 U
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.5-5. Detected Chemicals in Groundwater—Line 3A

Iowa Army Ammunition Plant, . Summary of Chemicals Detected in Groundwater: Site Line 3A

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	L3A-TW19-03	L3A-TW19-04A	L3A-TW19-04B
					Sample ID	L3A-TW19-03-1020-0419	L3A-TW19-04A-1525-0719	L3A-TW19-04B-5060-0419
					Sample Depth (ft)	10 - 20	15 - 25	43 - 53
					Sample Date	4/27/2019	7/11/2019	4/29/2019
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.42 U	0.41 U	0.42 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.3 U	0.29 U	0.31 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.42 U	0.41 U	0.42 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.21 U	0.2 U	0.21 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.13 U	0.12 U	0.13 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.13 U	0.12 U	0.13 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.42 U	0.41 U	**0.27 J**
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.26 U	0.25 U	**0.1 J**
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.26 U	0.25 U	0.26 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.21 U	0.2 U	0.21 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.21 U	0.2 U	0.21 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.42 U	0.41 U	0.42 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.21 U	0.2 U	0.21 U
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -

Notes:
DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane
MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one
RDX = 1,3,5-trinitro-1,3,5-triazine
TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol
B = The analyte was detected in the associated method and/or calibration blank.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
-- = Not Analyzed
µg/L = Micrograms per Liter
Bold indicates the analyte was detected
Italics indicates the result exceeded screening criteria
Shading indicates the result exceeded screening criteria and background value, if applicable.
*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.
MCL = Maximum Contaminant Level
Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.
Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.
Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)
(1) UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.5-6. Groundwater Quality Parameters—Line 3A

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (uS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
JAW-15	8/17/2018	12.47	6.53	17.1	501	190.5	1.12	8.66
JAW-16	8/16/2018	38.88	7.21	21.17	442	196.2	18.57	49.6
JAW-17	8/17/2018	11.6	6.85	20.03	475	177	1.3	6.87
JAW-18[a]	8/30/2018	51.4	NA	NA	NA	NA	NA	NA
JAW-19	8/16/2018	14.92	6.55	16.2	560	219.9	2.19	7.73
JAW-20	8/16/2018	41.16	7.26	18.51	386	173.5	8.21	63.6
JAW-21	8/16/2018	11	6.89	18.16	262	161.9	10.06	5.37
JAW-22	8/16/2018	12.4	6.82	18.2	610	202	7.72	6.51
L3A-MW1A	8/22/2018	12.96	7.71	15.49	640	228.4	8.46	144
L3A-MW1B	8/21/2018	15.65	6.98	14	467	161.2	2.83	overrange
L3A-MW3A	8/22/2018	11.12	7.07	14.05	557	239.5	8.28	136
L3A-MW3B	8/22/2018	19.85	7.44	15.98	567	269.1	3.39	71.8
L3A-MW4A	8/22/2018	11.11	7.88	17.18	366	244.5	9.47	20.2
L3A-MW4B	8/21/2018	48.42	7.03	15.5	530	131.6	1.79	8.6
L3A-MW5A	8/22/2018	11.48	7.21	12.8	408	195.9	10.13	96.3
L3A-MW5B	8/22/2018	42.72	8.56	13.6	406	211.3	7.62	overrange
L3A-MW6A	8/28/2018	9.82	7.14	16.2	660	44.1	4.71	2.96
L3A-MW6B	8/28/2018	39.3	6.97	13.7	750	-43.3	0.18	237
L3A-MW7[b]	8/17/2018	41.3	NA	NA	NA	NA	NA	NA
L3A-TW19-01	4/28/2019	NM	6.58	9.1	357	-70.3	1.9	530
L3A-TW19-02	4/27/2019	NM	7.37	8.27	384	-125.9	2.18	110
L3A-TW19-03	4/27/2019	NM	6.92	7.57	471	-74.1	1.78	67.4
L3A-TW19-04A	4/28/2019	NM	dry	dry	dry	dry	dry	dry
L3A-TW19-04B	4/28/2019	NM	dry	dry	dry	dry	dry	dry

Notes:

Water quality parameters were measured in the field using a YSI multi-meter.

Depth to water measurements represent static water levels measurement prior to low-flow purge.

[a] No groundwater parameters were collected at JAW-18 due to an obstruction in the well.

[b] No groundwater parameters were collected at L3A-MW7 as the pump stopped working.

°C = degrees Celsius

DO = dissolved oxygen

mV = millivolt(s)

NTU = nephelometric turbidity unit

ORP = oxidation-reduction potential

ug/L = microgram(s) per liter

uS/cm = microsiemen(s) per centimeter

ft = feet

btoc = below top of casing

NM = Not Measured

Table 5.5-8. Data Groupings Used in the HHRA—Line 3A

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Description	Sample Count
AOC_GW	Groundwater at Line 3A	54
AOC_GW-CW	Shallow groundwater (≤10 feet bgs) in trench/culvert	26

Table 5.5-9. Samples Used in the HHRA—Line 3A

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW	AOC_GW-CW	WG	JAW-15	JAW-15-20031118	11/18/2003 (3)	5	20
AOC_GW	AOC_GW-CW	WG	JAW-15	S06-JAW-15-GW-REG	4/24/2006 (2)	5	20
AOC_GW	AOC_GW-CW	WG	JAW-15	F06-JAW-15-GW-REG	9/8/2006 (2)	5	20
AOC_GW	AOC_GW-CW	WG	JAW-15	S07-JAW-15-GW-REG	6/7/2007 (2)	5	20
AOC_GW	AOC_GW-CW	WG	JAW-15	JAW-15-0818	8/17/2018	5	20
AOC_GW		WG	JAW-16	JAW-16-20031119	11/19/2003 (3)	43	58
AOC_GW		WG	JAW-16	JAW-16-0818	8/16/2018	43	58
AOC_GW	AOC_GW-CW	WG	JAW-17	JAW-17-20031117	11/17/2003 (3)	5	15
AOC_GW	AOC_GW-CW	WG	JAW-17	S06-JAW-17-GW-REG	4/24/2006 (2)	5	15
AOC_GW	AOC_GW-CW	WG	JAW-17	F06-JAW-17-GW-REG	9/8/2006 (2)	5	15
AOC_GW	AOC_GW-CW	WG	JAW-17	S07-JAW-17-GW-REG	6/8/2007 (2)	5	15
AOC_GW	AOC_GW-CW	WG	JAW-17	JAW-17-0818	8/17/2018	5	15
AOC_GW		WG	JAW-18	JAW-18-20040616	6/16/2004 (3)	36	51
AOC_GW		WG	JAW-18	S06-JAW-18-GW-REG	4/24/2006 (2)	36	51
AOC_GW		WG	JAW-18	L3A-JAW-18-0818	8/30/2018	36	51
AOC_GW	AOC_GW-CW	WG	JAW-19	JAW-19-051700	5/17/2000 (2)	5	15
AOC_GW	AOC_GW-CW	WG	JAW-19	JAW-19-20031118	11/18/2003 (3)	5	15
AOC_GW	AOC_GW-CW	WG	JAW-19	S06-JAW-19-GW-REG	4/24/2006 (2)	5	15
AOC_GW	AOC_GW-CW	WG	JAW-19	JAW-19-0818	8/16/2018	5	15
AOC_GW		WG	JAW-20	JAW-20-20031117	11/17/2003 (3)	5	20
AOC_GW		WG	JAW-20	F05-JAW-20-GW-REG	1/29/2006 (2)	5	20
AOC_GW		WG	JAW-20	S06-JAW-20-GW-REG	4/9/2006 (2)	5	20
AOC_GW		WG	JAW-20	F06-JAW-20-GW-REG	9/11/2006 (2)	5	20
AOC_GW		WG	JAW-20	S07-JAW-20-GW-REG	6/8/2007 (2)	5	20
AOC_GW		WG	JAW-20	JAW-20-0818	8/16/2018	5	20
AOC_GW	AOC_GW-CW	WG	JAW-21	JAW-21-20031117	11/17/2003 (3, 4)	43	58
AOC_GW	AOC_GW-CW	WG	JAW-21	F05-JAW-21-GW-REG	1/29/2006 (2, 4)	43	58
AOC_GW	AOC_GW-CW	WG	JAW-21	S06-JAW-21-GW-REG	4/9/2006 (2, 4)	43	58
AOC_GW	AOC_GW-CW	WG	JAW-21	F06-JAW-21-GW-REG	9/10/2006 (2, 4)	43	58
AOC_GW	AOC_GW-CW	WG	JAW-21	S07-JAW-21-GW-REG	6/8/2007 (2, 4)	43	58
AOC_GW	AOC_GW-CW	WG	JAW-21	JAW-21-0818	8/16/2018 (4)	43	58
AOC_GW	AOC_GW-CW	WG	JAW-22	JAW-22-20031118	11/18/2003 (3)	5	20
AOC_GW	AOC_GW-CW	WG	JAW-22	F05-JAW-22-GW-REG	1/29/2006 (2)	5	20
AOC_GW	AOC_GW-CW	WG	JAW-22	S06-JAW-22-GW-REG	4/9/2006 (2)	5	20
AOC_GW	AOC_GW-CW	WG	JAW-22	F06-JAW-22-GW-REG	9/10/2006 (2)	5	20

Table 5.5-9. Samples Used in the HHRA—Line 3A

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW	AOC_GW-CW	WG	JAW-22	S07-JAW-22-GW-REG	6/7/2007 (2)	5	20
AOC_GW	AOC_GW-CW	WG	JAW-22	JAW-22-0818	8/16/2018	5	20
AOC_GW		WG	L3A-MW1A	L3A-MW1A-0818	8/22/2018	10	30
AOC_GW		WG	L3A-MW1B	L3A-MW1B-0818	8/21/2018	42.5	52.5
AOC_GW		WG	L3A-MW3A	L3A-MW3A-0818	8/22/2018	15	25
AOC_GW		WG	L3A-MW3B	L3A-MW3B-0818	8/22/2018	36	46
AOC_GW		WG	L3A-MW4A	L3A-MW4A-0818	8/22/2018	10	20
AOC_GW		WG	L3A-MW4B	L3A-MW4B-0818	8/21/2018	45	55
AOC_GW		WG	L3A-MW5A	L3A-MW5A-0818	8/22/2018	10	20
AOC_GW		WG	L3A-MW5B	L3A-MW5B-0818	8/22/2018	35	45
AOC_GW		WG	L3A-MW6A	L3A-MW6A-0818	8/29/2018	10	25
AOC_GW		WG	L3A-MW6B	L3A-MW6B-0818	8/29/2018	52.5	62.5
AOC_GW		WG	L3A-MW7	L3A-MW7-0818	8/30/2018	52	62
AOC_GW		WG	L3A-TTTW-001	L3A-TTTW-001	2/10/2007 (2)	4	24
AOC_GW		WG	L3A-TW19-01	L3A-TW19-01-1020-0419	4/28/2019	10	20
AOC_GW		WG	L3A-TW19-02	L3A-TW19-02-1020-0419	4/27/2019	10	20
AOC_GW		WG	L3A-TW19-03	L3A-TW19-03-1020-0419	4/27/2019	10	20
AOC_GW		WG	L3A-TW19-04A	L3A-TW19-04A-1525-0719	7/11/2019	15	25
AOC_GW		WG	L3A-TW19-04B	L3A-TW19-04B-5060-0419	4/29/2019	43	53

Notes:

(1) The data were reduced such that when a normal and duplicate sample were available, the highest detected concentration among normal or duplicate samples was used when a chemical was detected in any sample. If both results were non-detect, the lowest reported detection limit (i.e., reporting limit) was used.

(2) Only SVOC and VOC data from this sample were used in the evaluation because more recent data were available for the other analytes (explosives and metals).

(3) Only metals data from this sample were used in the evaluation because more recent data were available for the other analytes (explosives, SVOCs, and VOCs).

(4) Depth to water ranged from 4.3 ft bgs to 14.3 bgs in sampling event from 1993 – 2007 and 2018.

WG = groundwater

SVOC = semivolatile organic compound

VOC = volatile organic compound

Table 5.6-1. Previous Investigations and Remedial Actions—Lines 5A/5B

Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Installation Assessment of IAAAP (USATHAMA, 1980)	1980	A records search was conducted to assess the use, storage, treatment, and disposal of toxic and hazardous materials at IAAAP regarding environmental quality.	Lines 5A and 5B were constructed in 1941 and used for pelletizing and assembling explosive components produced for IAAAP. The principal explosives used at both lines were TNT, RDX, and tetryl. A follow-on preliminary survey was recommended to assess potential soil contamination and potential contaminant migration off the facility.
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	1991	A preliminary assessment was conducted for Lines 5A and 5B to evaluate the potential for contamination and assess potential migration pathways and exposure potential if contamination were present.	It was recommended that soil, and possibly sediment, sampling be conducted near treatment sumps and drainage pathways. The principal explosives used at both lines were TNT and RDX.
Facility-wide Site Inspection (JAYCOR, 1992)	1991	Nineteen soil samples were collected from around the treatment sumps at Lines 5A and 5B at depths ranging from 0 to 1 feet bgs and analyzed for metals and explosives.	Explosives were detected in 7 of the 19 samples, with the highest concentrations adjacent to Building 5A-140-2 and around the sumps at Line 5B. Metals were detected above assumed background levels in 8 of the 19 samples. It was recommended that Lines 5A and 5B be further investigated in the Phase I RI to determine the extent of metals and explosives contamination.
Facility-wide Phase I Remedial Investigation (JAYCOR, 1993a)	1992–1993	Phase I RI sampling included soil and soil gas sampling: • One hundred twenty-four explosives and 112 metals screening samples were collected in soil around sumps and drainageways. • Sixteen surface soil samples were collected for laboratory analysis; samples were analyzed for explosives or metals. • Eleven subsurface soil samples were collected for laboratory analysis; samples were analyzed for explosives, metals, VOCs, SVOCs, pesticides, or PCBs. • A soil gas survey was conducted around the solvent storage Building 5B-03-3 at Line 5B. Fourteen soil gas samples were collected to assess VOCs. Concurrently with the RI, an independent study involving 36 sumps was conducted by JAYCOR. Surface soil and at-depth soil samples were collected around four sumps at Line 5A and five sumps at Line 5B. The 35 soil samples were analyzed for explosives or metals.	Results of the metals and explosives screening indicated localized metals and explosives contamination around sumps. The maximum depth of metals contamination was 2 feet bgs while the maximum depth of explosives contamination was 4 feet bgs. All metals were detected below 100 µg/g. Areas with explosives contamination were identified adjacent to sumps at Buildings 5A-56, 5A-140-1, 5A-99-2, 5A-28, 5A-26, and 5A-140-2. In soil gas, VOC levels were below the evaluation protocol of 5.0 µg/L. No further action was recommended following the soil gas survey because the range of VOC concentrations was not considered significant. No Phase II RI activities were proposed for Lines 5A and 5B.

Table 5.6-1. Previous Investigations and Remedial Actions—Lines 5A/5B
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Follow-on Remedial Investigation (JAYCOR, 1996)	1995	Two new monitoring wells (JAW-606 and JAW-609) were installed south of Building 5A-28 at Line 5A, and two new monitoring wells (JAW-607 and JAW-608) were installed at Line 5B. All wells were sampled and analyzed for explosives, metals, PCBs, pesticides, SVOCs, and VOCs.	In groundwater, BEHP and manganese were the only compounds detected above the comparison criteria, in shallow well JAW-606. The report concluded that metals detections were likely due to suspended solids.
Sump Removal Action (OHM, 1996)	1995	Eight sumps were removed at Line 5A and 10 sumps were removed at Line 5B. Both steel sumps/tanks and concrete sumps were removed, and the soils surrounding concrete sumps were excavated. A total of 108 cubic yards of soils were excavated and treated/disposed of at the Inert Disposal Area.	Confirmation samples were taken and analyzed for metals and explosives prior to backfilling.
Periodic Groundwater Monitoring (multiple reports)	1996–2008	Periodic groundwater sampling was conducted at Lines 5A and 5B per the FFA and recommendations in the 1996 RI. Permanent monitoring wells 5A-MW1, 5A-MW2, 5B-MW1, 5B-MW2, JAW-606, JAW-607, JAW-608, and JAW-609 were sampled multiple times and analyzed for explosives, metals, SVOCs, and VOCs depending on the sampling event.	Explosives, metals, VOCs, and SVOCs were detected in groundwater samples. Metals that exceeded screening levels throughout included arsenic, barium, lead, and manganese. All metals exceedances were observed prior to October 2000, after which concentrations decreased and remained below screening levels. BEHP was detected above the MCL (6 µg/L) once in two wells, both prior to October 2000, after which concentrations remained below screening levels. Six explosives (RDX, 2,4,6-TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2,4-DNT, and 2,6-DNT) exceeded screening levels at Line 5A. Only RDX exceeded screening levels at Line 5B (well 5B-MW1) through 2008. During the last event in 2008, RDX was detected at a maximum concentration of 47.8 µg/L and TNT was detected at a maximum concentration of 4.5 µg/L.
Record of Decision for Soils OU-1 (Harza, 1998)	1998	The Final ROD for OU-1 was issued to address contaminated soils at IAAAP. The ROD presented the selected remedial action for OU-1.	The selected remedy included excavation for soil contaminated with metals and explosives at Lines 5A and 5B.
Predesign Excavation Delineation (USACE, 1998)	1998	USACE conducted additional soil sampling to determine the aerial and vertical extent of explosives and metals contamination above RGs at Line 5A and 5B. Samples were collected in regions previously not sampled during the SI or RI, including low-lying drainage ways or areas that flood during rainfall events, suspected to be contaminated with sedimentary deposition of explosives.	The areas investigated indicated no explosive contamination at the surface to the maximum sampling depth of 2.5 feet bgs, and no metals contamination above RGs. The conclusions of the sampling event were that the sampled regions at the time did not require remedial action, soils had been adequately investigated at Lines 5A and 5B, and no data gaps were present.

Table 5.6-1. Previous Investigations and Remedial Actions—Lines 5A/5B

Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Remedial Action for OU-1 Soils Phase 2 (ECC, 2001b)	1999	Prior to soil removal, site characterization sampling was conducted. 731 soil samples were collected at Line 5A and 693 soil samples were collected at Line 5B. 1,065 cubic yards of contaminated soil were removed at the site to depths ranging from 1 to 5 feet bgs, primarily at Buildings 5A-26, 5A-28, 5A-99-1, 5A-140-1, 5A-140-2, 5A-140-3, 5B-26, 5B-28, and 5B-140-3.	The site characterization sampling identified explosives, metals, total petroleum hydrocarbons, VOCs, SVOCs, and pesticides as soil COCs. Verification samples, collected after the soil excavations, contained no contamination above RGs. Based on the results from confirmation analyses, which indicated no soils above comparison criteria, soil actions at this site were considered complete.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	2005	A comprehensive evaluation was conducted of all IAAAP sites and the four primary watersheds (Brush Creek, Spring Creek, Long Creek, and Skunk River) to identify data gaps and additional data needed to complete a feasibility study for surface water and groundwater at each of the IAAAP sites.	The work plan concluded that soil, surface water, and sediment had been adequately characterized and no adverse impacts from the sumps or the outfalls to the environment were identified based on extensive historical sampling results. Groundwater monitoring data indicated RDX and TNT concentrations above comparison criteria in several wells through 2004. The reported noted that no groundwater samples had been collected from the downgradient sides of the site (southeast at Line 5A, southwest at Line 5B) to monitor migration of contamination. Additional groundwater monitoring for explosives was recommended for wells 5A-MW1, 5A-MW2, 5B-MW1, and JAW-606. DPT groundwater samples were proposed at the southeast side of Line 5A and southwest of well 5B-MW1 to determine if there was horizontal migration of the plume in the direction of Brush Creek or Long Creek, respectively.
OU-6 Supplemental Remedial Investigation (Tetra Tech, 2012a)	2006-2007	Two temporary monitoring wells (L5A-TTTW-001 and L5B-TTTW-001) were drilled in 2006 and sampled in 2007 to delineate downgradient contamination. Groundwater samples were analyzed for explosives. The temporary wells were abandoned shortly after they were sampled.	TNT was detected below its tap water RSL in the downgradient temporary well at Line 5A. No explosives were detected in the downgradient temporary well at Line 5B.
Explanation of Significant Differences for the Records of Decision Soils OU-1 (Leidos, 2018)	2018	Documented the addition of LUCs to the selected remedy for the soils ROD to provide overall protectiveness of human health and the environment.	The Explanation of Significant Differences changes will apply to soil at Line 5A/5B.

Table 5.6-1. Previous Investigations and Remedial Actions—Lines 5A/5B
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
OU-1 Land Use Controls Implementation Plan (Leidos, 2019)	2019	Outlined the process for implementation and maintenance of LUCs as a component of the selected remedy for OU-1. Institutional controls will be used to restrict land use at OU-1 areas to military, commercial/industrial, agricultural, and permitted hunting and to prohibit residential use. Engineering controls (fencing, signs) will be used to prevent general access to areas.	The scope of the LUCIP applies to Line 5A/5B.

Table 5.6-3. Monitoring Well Construction Details—Line 5A

Iowa Army Ammunition Plant, Middletown, IA

Well Location	Screen Interval (feet bgs)	Filter Pack Interval (feet bgs)	Borehole Depth (feet bgs)	Well Casing Diameter (inches)	Top of Casing Elevation (feet amsl)
5A-MW3	45 to 55	42 to 55	55	2	725.26
5A-MW4	10 to 20	8 to 20	20	2	726.31
5A-MW5	10 to 20	9 to 20	20	2	726.78
5A-MW6	15 to 25	13 to 25	25	2	727.51

Notes:

Borehole diameter was 8 inches for all monitoring wells.

amsl = above mean sea level

bgs = below ground surface

Table 5.6-4. Monitoring Well Construction Details—Line 5B

Iowa Army Ammunition Plant, Middletown, IA

Well Location	Screen Interval (feet bgs)	Filter Pack Interval (feet bgs)	Borehole Depth (feet bgs)	Well Casing Diameter (inches)	Top of Casing Elevation (feet amsl)
5B-MW3	43 to 53	39 to 53	53	2	728.73
5B-MW4	7 to 17	6 to 17	17	2	727.99

Notes:

Borehole diameter was 8 inches for all monitoring wells.

amsl = above mean sea level

bgs = below ground surface

Table 5.6-5. Gauging Information—Line 5A

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval (ft btoc)	Depth to Water (ft btoc)	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)
5A-MW1	12/10/2019	7.5-17	5.05	726.14	721.09
5A-MW2	12/10/2019	7.5-17	4.74	726.83	722.09
5A-MW3	12/10/2019	45-55	6.6	725.258	718.658
5A-MW4	12/10/2019	10-20	4.32	726.314	721.994
5A-MW5	12/10/2019	10-20	5.67	726.783	721.113
5A-MW6	12/10/2019	15-25	5.34	727.514	722.174
JAW-606	12/10/2019	5-15	5.57	722.294	716.724
JAW-609	12/10/2019	102-112	50.52	722.191	671.671

Notes:

ft = feet

btoc = below top of casing

amsl = above mean sea level

Table 5.6-6. Gauging Information—Line 5B

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval (ft btoc)	Depth to Water (ft btoc)	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)
JAW-607	12/10/2019	6.5-15.5	5.45	730.111	724.661
JAW-608	12/10/2019	9-19	6.75	729.842	723.092
5B-MW1	12/10/2019	7.5-17	6.75	729.65	722.9
5B-MW2	12/10/2019	10-19.5	5.59	729.02	723.43
5B-MW3	12/10/2019	43-53	9.57	728.739	719.169
5B-MW4	12/10/2019	7-17	5.68	727.993	722.313

Notes:

ft = feet

btoc = below top of casing

amsl = above mean sea level

Table 5.6-7. Detected Chemicals in Groundwater—Line 5A

Iowa Army Ammunition Plant, Middletown, IA

					Location	5A-MW1							
					Sample ID	5A-MW1-052200	D013-052200	5A-MW1-20001020	5A-MW1-20010603	5A-MW1-20020616	5A-MW1-20030601	F06-5A-MW1-GW-REG	S07-5A-MW1-GW-REG
					Sample Depth (ft)	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17
					Sample Date	5/22/2000	5/22/2000	10/20/2000	6/3/2001	6/16/2002	6/1/2003	9/13/2006	6/5/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	**280000**	**280000**	**290000**	**293000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	**40**	**30**	20 U	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	**160000**	**120000**	**75000**	**435000**	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	300 U	300 U	300 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	**1600**	**1400**	**1100**	**1500**	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	**2000**	1000 U	**1000**	**6800**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	**140**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	**160**	**70**	**80**	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	**32000**	**28000**	**28000**	**18000**	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.16 U	0.16 U	0.79 U	0.6 U	0.71 U	0.99 U	**0.21**	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	**8.6**	0.75 U	**0.46 J**	**1.5 J**	**0.5**	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***8.7 J***	***6.8 J***	**1.2**	***9.7***	***6.9***	0.99 U	***4.7***	**0.92**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.16 U	0.16 U	0.79 U	0.6 U	0.71 U	0.99 U	0.19 U	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.31 U	0.31 U	0.79 U	0.6 U	0.71 U	0.99 U	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***5.2 J***	***5.4 J***	***2.9***	***8.6***	***8.5 J***	***2.3***	***7.3***	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***11 J***	***10 J***	***6***	***23***	***19 J***	***4.2***	***14.1***	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	**1.4**	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	**0.89**	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**21 J**	**36 J**	**12**	**4.1**	**4.3 J**	**6.6**	**3.4**	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***4.6 J***	***4.8 J***	***7***	***3.5***	***4.2 J***	**1.9**	***3.3***	***2.1***
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.4 U	2.4 U	10 U	10 U	10 U	10 U	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**229**	**204**	**185 J**	**325**	**244 J**	**219**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	0.4 U	5 U	**0.6 J**	5 U	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	**83100**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**44**	**14.8**	**5 J**	**0.6 J**	10 U	10 U	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**3.3 J**	**3.4 J**	10 U	10 U	10 U	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	**27300**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	0.1 U	0.21 U	0.21 U	0.2 U	**0.11 J**	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	2.6 U	10 U	**2.4 J**	10 U	10 U	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	2.8 U	10 U	10 U	10 U	**0.5 J**	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	**6150**	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	9 U	- -	***150***	5 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	3 U	2 U	3 U	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -

Notes:

DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol

B = The analyte was detected in the associated method and/or calibration blank.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

µg/L = Micrograms per Liter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)

[1] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.6-7. Detected Chemicals in Groundwater—Line 5A
Iowa Army Ammunition Plant, Middletown, IA

													5A-MW2	
					S08-5A-MW1-GW-REG	5A-MW1-0718	5A-MW2-052200	D014-052200	5A-MW2-20001020	5A-MW2-20010518	5A-MW2-20020616	5A-MW2-20030601	F04-GW-054	F06-5A-MW2-GW-REG
					7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17
					5/6/2008	7/23/2018	5/22/2000	5/22/2000	10/20/2000	5/18/2001	6/16/2002	6/1/2003	11/16/2004	9/12/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	- -	- -	- -	- -	- -	**150000**	**150000**	**170000**	**170000**	**157000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	- -	- -	- -	- -	- -	**30**	**20**	20 U	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	- -	- -	- -	- -	- -	**80000**	**66000**	**40000**	**7000**	**333000**
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	- -	- -	- -	- -	- -	**600**	300 U	300 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	- -	- -	- -	- -	- -	1000 U	**1200**	1000 U	1000 U	850 B
ANIONS	16887-00-6	Chloride	µg/L	--	- -	- -	- -	- -	- -	**3000**	**2000**	**2000**	**2000**	**7600**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	- -	- -	- -	- -	- -	- -	- -	- -	**200**	**140**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	- -	- -	- -	- -	- -	**520**	**310**	**80**	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	- -	- -	- -	- -	- -	**23000**	**40000**	**30000**	**31000**	**31800**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	- -	0.1 U	0.16 U	- -	1.4 U	**1 J**	**0.98 J**	**0.26 J**	**0.39 JP**	**0.65**
EXPLOSIVES	5755-27-1	MNX	µg/L	--	- -	**0.35 J**	- -	- -	1.4 U	**1.8**	**3.1 J**	**1.8 J**	**1.4**	**2**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	**0.064 J**	0.1 U	0.16 U	- -	1.4 U	***5.2***	***6.3***	0.25 U	**2.4**	***4.7***
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	- -	0.1 U	0.16 U	- -	1.4 U	***0.52 J***	1 U	**0.17 J**	**0.17 J**	**0.19**
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	- -	0.1 U	0.31 U	- -	1.4 U	1.1 U	1 U	0.25 U	0.51 U	***0.25***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	- -	**0.41**	***4.1 J***	- -	1.4 U	***27***	***30 J***	***14***	***15***	***21.2***
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	- -	**0.74**	***20 J***	- -	***44***	***76***	***65 J***	***43***	***62 D***	***65.8***
EXPLOSIVES	13980-04-6	TNX	µg/L	--	- -	**1.5**	- -	- -	- -	- -	- -	- -	0.51 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	- -	**1.7**	- -	- -	- -	- -	- -	- -	**0.44 J**	**0.58**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	- -	**6**	0.39 U	- -	1.4 U	**34**	**7.6 J**	**7 J**	**4.2 P**	**4**
EXPLOSIVES	121-82-4	RDX	µg/L	2	**1.7**	**0.36**	**1.3 J**	- -	**1.7**	***8.2***	***15***	***7.5***	***9.5***	***11***
METALS	7440-38-2	Arsenic	µg/L	10	- -	- -	**8.6 J**	***12.6***	10 U	10 U	10 U	10 U	20 U	- -
METALS	7440-39-3	Barium	µg/L	2000	- -	- -	**420**	**437**	**107 J**	**874**	**113 J**	**116 J**	123 B	- -
METALS	7440-43-9	Cadmium	µg/L	5	- -	- -	**0.8 J**	**1 J**	5 U	**0.3 J**	5 U	5 U	1.2 B	- -
METALS	7440-70-2	Calcium	µg/L	--	- -	- -	- -	- -	- -	**41000**	- -	- -	**39000**	- -
METALS	7440-47-3	Chromium	µg/L	100	- -	- -	**70.1**	**72.5**	**2.8 J**	**2.4 J**	10 U	10 U	0.83 B	- -
METALS	7439-92-1	Lead	µg/L	15	- -	- -	***22.8***	***22.7***	10 U	**1.5 J**	10 U	10 U	3.9 B	- -
METALS	7439-95-4	Magnesium	µg/L	--	- -	- -	- -	- -	- -	**14300**	- -	- -	**13500**	- -
METALS	7439-96-5	Manganese	µg/L	430	- -	- -	- -	- -	- -	- -	- -	- -	**60.8 E**	- -
METALS	7439-97-6	Mercury	µg/L	2	- -	- -	0.1 U	0.1 U	0.21 U	0.21 U	0.2 U	**0.2**	0.2 U	- -
METALS	7440-09-7	Potassium	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	**353 BE**	- -
METALS	7782-49-2	Selenium	µg/L	50	- -	- -	**4.1 J**	**4.1 J**	10 U	10 U	10 U	10 U	2.7 B	- -
METALS	7440-22-4	Silver	µg/L	130	- -	- -	2.8 U	2.8 U	10 U	10 U	10 U	10 U	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	- -	- -	- -	- -	- -	**25200**	- -	- -	**19700 E**	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	- -	- -	10 U	- -	**1 J**	5 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	- -	- -	- -	- -	- -	3 U	2 U	3 U	**4.6**	- -
VOLATILES	74828	Methane	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	**6**	- -

Notes:
DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane
MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one
RDX = 1,3,5-trinitro-1,3,5-triazine
TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol
B = The analyte was detected in the associated method and/or calibration blank.
E = Sample result over the calibration range, considered an estimated result.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
µg/L = Micrograms per Liter
Bold indicates the analyte was detected
Italics indicates the result exceeded screening criteria
Shading indicates the result exceeded screening criteria and background value, if applicable.
*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.
MCL = Maximum Contaminant Level
Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.
Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.
Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)

(1) UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.6-7. Detected Chemicals in Groundwater—Line 5A

Iowa Army Ammunition Plant, Middletown, IA

									5A-MW3	5A-MW4	5A-MW5		5A-MW6
					S07-5A-MW2-GW-REG	S08-5A-MW2-GW-FD	S08-5A-MW2-GW-REG	5A-MW2-0718	5A-MW3-0718	5A-MW4-0718	5A-MW5-0718	5A-MWF5-0718	5A-MW6-0718
					7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	45 - 55	10 - 20	10 - 20	10 - 20	15 - 25
					6/6/2007	5/6/2008	5/6/2008	7/23/2018	7/24/2018	7/20/2018	7/22/2018	7/22/2018	7/20/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	- -	- -	- -	**0.069 J**	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
EXPLOSIVES	5755-27-1	MNX	µg/L	--	- -	- -	- -	**1.2 J**	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	**2.4**	***4.5***	***4.4***	**0.68 J**	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	- -	- -	- -	1 U	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	- -	- -	- -	1 U	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	- -	- -	- -	***6.9 J***	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	- -	- -	- -	***43***	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
EXPLOSIVES	13980-04-6	TNX	µg/L	--	- -	- -	- -	**0.077 J**	0.23 U	0.2 UJ	0.2 U	0.2 U	0.2 UJ
EXPLOSIVES	DNX	DNX	µg/L	--	- -	- -	- -	**0.89 J**	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	- -	- -	- -	**6.6 J**	0.12 U	0.1 UJ	**0.053 J**	**0.073 J**	0.1 UJ
EXPLOSIVES	121-82-4	RDX	µg/L	2	***7.1***	***7***	***6.3***	***6.5 J***	0.12 U	0.1 UJ	0.1 U	0.1 U	0.1 UJ
METALS	7440-38-2	Arsenic	µg/L	10	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

Notes:

DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol

B = The analyte was detected in the associated method and/or calibration blank.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

µg/L = Micrograms per Liter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)

[1] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.6-7. Detected Chemicals in Groundwater—Line 5A
Iowa Army Ammunition Plant, Middletown, IA

					JAW-606		JAW-609			L5A-TTTW-001
					F06-JAW-606-GW-REG	JAW-606-0718	F06-JAW-609-GW-REG	JAW-609-0718	JAW-609F-0718	L5A-TTTW-01
					5 - 15	5 - 15	102 - 112	102 - 112	102 - 112	unknown
					9/12/2006	7/22/2018	9/13/2006	7/24/2018	7/24/2018	2/13/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***						
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	**263000**	- -	**453000**	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	**390000**	- -	**487000**	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	880 B	- -	**1000**	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	**7800**	- -	**11300**	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	50 U	- -	**400**	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	**26700**	- -	**32600**	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	0.2 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	**0.13 J**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	0.19 U	0.21 U	0.19 U	0.2 U	0.2 U	- -
EXPLOSIVES	DNX	DNX	µg/L	--	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	0.19 U	0.1 U	0.19 U	0.1 U	0.098 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	- -	- -	- -	- -	- -	- -

Notes:
DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane
MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one
RDX = 1,3,5-trinitro-1,3,5-triazine
TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol
B = The analyte was detected in the associated method and/or calibration blank.
E = Sample result over the calibration range, considered an estimated result.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
µg/L = Micrograms per Liter
Bold indicates the analyte was detected
Italics indicates the result exceeded screening criteria
Shading indicates the result exceeded screening criteria and background value, if applicable.
*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.
MCL = Maximum Contaminant Level
Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.
Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.
Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)
[(1)] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.6-8. Detected Chemicals in Groundwater—Line 5B

Iowa Army Ammunition Plant, Middletown, IA

					Location	5B-DP1	5B-DP2	5B-MW1									
					Sample ID	5B-DP1-0618	5B-DP2-0618	5B-MW1-052200	5B-MW1-20001022	5B-MW1-20010518	5B-MW1-20020616	5B-MW1-20030601	F04-GW-060	F06-5B-MW1-GW-REG	S07-5B-MW1-GW-REG	S08-5B-MW1-GW-REG	5B-MW1-0718
					Sample Depth (ft)	11.3 - 15	11.3 - 15	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17	7.5 - 17
					Sample Date	6/21/2018	6/21/2018	5/22/2000	10/22/2000	5/18/2001	6/16/2002	6/1/2003	11/17/2004	9/12/2006	6/6/2007	5/6/2008	7/23/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**												
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	**260000**	**280000**	**260000**	**290000**	**260000**	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	10 U	10 U	**50**	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	**60000**	**120000**	**34000**	**5300**	**386000**	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	300 U	300 U	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	1000 U	**1000**	1000 U	1000 U	**830 J**	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	**3000**	**2000**	**2000**	**1000**	**7100 J**	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	**600**	**760 J**	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	**510**	**570**	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	**24000**	**24000**	**24000**	**21000**	**18400 J**	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.11 UJ	**0.41 J**	- -	0.77 U	**1.7**	**0.89**	**1 J**	**1.1**	**1.8**	- -	- -	**0.3 J**
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.11 UJ	0.1 UJ	0.31 U	0.77 U	0.82 U	0.27 U	0.78 U	0.48 U	**0.069 J**	- -	- -	0.1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.11 UJ	0.1 UJ	**14 J**	**11**	**27**	**24 J**	**13**	**18**	**22.8**	- -	- -	**5.4**
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.11 UJ	0.1 UJ	***6.6 J***	***12***	***46***	***42***	***29***	***38***	***54.7***	***80.3***	***47.8***	***9.4***
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	**2.8 J**	**7 J**	10 U	10 U	10 U	20 U	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	**146**	**199 J**	**157 J**	**137 J**	**142 J**	154 B	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	0.4 U	5 U	**0.4 J**	5 U	5 U	0.55 B	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	**70000**	- -	- -	**65000**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	**13.7**	**1.1 J**	**2.4 J**	10 U	**4.9 J**	0.82 B	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	**3.6 J**	10 U	10 U	10 U	10 U	10 U	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	**28500**	- -	- -	**25500**	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	0.1 U	0.21 U	0.21 U	0.2 U	**0.04 J**	0.2 U	- -	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	**189 BE**	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	**3.3 J**	**3.1 J**	**2.5 J**	**2.8 J**	10 U	3.1 B	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	**5970**	- -	- -	**9610 E**	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	3 U	2 U	3 U	**3 J**	- -	- -	- -	- -

Notes:

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

B = The analyte was detected in the associated method and/or calibration blank.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

µg/L = Micrograms per Liter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)

[(1)] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.6-8. Detected Chemicals in Groundwater—Line 5B

Iowa Army Ammunition Plant, Middletown, IA

					Location	5B-MW2								5B-MW3	5B-MW4	JAW-607	
					Sample ID	5B-MW2-052200	D012-052200	5B-MW2-20001021	5B-MW2-20010517	5B-MW2-20020616	5B-MW2-20030601	F06-5B-MW2-GW-REG	5B-MW2-0718	5B-MW3-0718	5B-MW4-0718	F06-JAW-607-GW-REG	JAW-607-0718
					Sample Depth (ft)	10 - 19.5	10 - 19.5	10 - 19.5	10 - 19.5	10 - 19.5	10 - 19.5	10 - 19.5	10 - 19.5	43 - 53	7 - 17	6.5 - 15.5	6.5 - 15.5
					Sample Date	5/22/2000	5/22/2000	10/21/2000	5/17/2001	6/16/2002	6/1/2003	9/11/2006	7/23/2018	7/24/2018	7/22/2018	9/12/2006	7/23/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**												
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	**150000**	**180000**	**180000**	**210000**	- -	- -	- -	**313000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	10 U	10 U	**50**	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	**38000**	**79000**	**42000**	**321000**	- -	- -	- -	**478000**	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	**400**	300 U	**400**	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	**1200**	**1400**	**1000**	**1200**	- -	- -	- -	780 B	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	**5000**	**4000**	**3000**	**8200**	- -	- -	- -	**8300**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	60 B	- -	- -	- -	**190**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	**990**	**150**	**60**	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	**28000**	**28000**	**34000**	**25500**	- -	- -	- -	**38000**	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.65 U	1.5 U	0.34 U	0.17 U	**0.12 J**	0.1 U	0.099 U	0.099 U	0.19 U	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.38 U	0.4 U	0.65 U	1.2 U	0.27 U	0.17 U	0.19 U	0.1 U	0.099 UJ	0.099 U	0.19 U	0.1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**0.47 J**	**0.47 J**	**0.34**	1.2 U	**0.84 J**	**0.36 J**	**0.53**	**0.92**	0.099 UJ	0.099 U	0.19 U	0.1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	**0.56 J**	**0.61 J**	**0.56**	**0.66**	**0.77**	**0.35**	**0.51**	**0.62**	0.099 U	0.099 U	0.19 U	0.1 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.4 U	2.4 U	**2.7 J**	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**150**	**139**	**137 J**	**102 J**	**90.3 J**	**106 J**	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	0.4 U	5 U	**0.4 J**	5 U	5 U	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	**46500**	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**25.3**	**19.8**	**2.2 J**	**1.3 J**	10 U	10 U	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**4 J**	**3.1 J**	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	**17500**	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	0.1 U	0.21 U	0.21 U	0.2 U	**0.06 J**	- -	- -	- -	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	2.6 U	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	**8150**	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	3 U	2 U	3 U	- -	- -	- -	- -	- -	- -

Notes:

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

B = The analyte was detected in the associated method and/or calibration blank.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

µg/L = Micrograms per Liter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)

[1] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.6-8. Detected Chemicals in Groundwater—Line 5B

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-608		L5B-TTTW-001
					Sample ID	F06-JAW-608-GW-REG	JAW-608-0718	L5B-TTTW-01
					Sample Depth (ft)	9 - 19	9 - 19	unknown
					Sample Date	9/11/2006	7/23/2018	2/13/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**			
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**202000**	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**214000**	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1500**	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**8400**	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	90 B	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**67600**	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	0.1 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.1 U	0.25 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	0.1 U	0.25 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	0.1 U	0.25 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -
METALS	7440-09-7	Potassium	µg/L	--	2540	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -

Notes:

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

B = The analyte was detected in the associated method and/or calibration blank.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

µg/L = Micrograms per Liter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M, 2020a)

[1] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.6-9. Groundwater Quality Parameters—Line 5A

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (µS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
5A-MW1	7/23/2018	5.05	6.83	19	517	181	0.42	11.4
5A-MW2	7/23/2018	4.74	6.69	19.9	318	202.9	2.8	9.2
5A-MW3	7/24/2018	6.6	6.94	21.7	1000	124	3.12	432
5A-MW4	7/20/2018	4.32	7.06	16	586	118.3	1.07	37.3
5A-MW5	7/22/2018	5.67	7.27	18.1	455.5	119	2.17	57.3
5A-MW6	7/20/2018	5.34	7.47	16.9	415	84.2	1.48	26.4
JAW-606	7/22/2018	5.57	6.8	15.7	419	-1.8	0.31	65.8
JAW-609	7/24/2018	50.52	7.16	14.7	800	-73.2	0.17	overrange

Notes:

Water quality parameters were measured in the field using a YSI multi-meter.

°C = degrees Celsius
DO = dissolved oxygen
mV = millivolt(s)
NTU = nephelometric turbidity unit
ORP = oxidation-reduction potential
µg/L = microgram(s) per liter
µS/cm = microsiemen(s) per centimeter
ft = feet
btoc = below top of casing

Table 5.6-10. Groundwater Quality Parameters—Line 5B

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (µS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
5B-MW1	7/23/2018	6.75	6.94	19.4	535	147.3	1.28	37.3
5B-MW2	7/23/2018	5.59	7.53	16.9	415	188.1	0.38	7.91
5B-MW3	7/24/2018	9.57	6.9	17	1070	118.1	0.79	overrange
5B-MW4	7/22/2018	5.68	7.48	17.3	499	102.7	2.8	130
JAW-607	7/23/2018	5.45	7.01	17.2	475	143	1.53	46.9
JAW-608	7/23/2018	6.75	6.98	17.5	570	96.3	0.62	29.8

Notes:

Water quality parameters were measured in the field using a YSI multi-meter.

°C = degrees Celsius

DO = dissolved oxygen

mV = millivolt(s)

NTU = nephelometric turbidity unit

ORP = oxidation-reduction potential

µg/L = microgram(s) per liter

µS/cm = microsiemen(s) per centimeter

ft = feet

btoc = below top of casing

Table 5.6-12. Data Groupings Used in the HHRA—Lines 5A and 5B

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Description	Sample Count
Line5A_GW	Groundwater at Line 5A	10
Line5A_GW-CW	Shallow groundwater (DTW ≤ 10 feet bgs) in a culvert/trench at Line 5A	9
Line5B_GW	Groundwater at Line 5B (1)	10

Note:

(1) Shallow groundwater in a trench/culvert was not evaluated for Line 5B because a hypothetical residential scenario did not exceed acceptable risk levels and COCs were not identified for a residential scenario.

bgs = below ground surface

COC = chemical of concern

DTW = depth to water

Table 5.6-13. Samples Used in the HHRA—Lines 5A and 5B

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected (2)	Upper Depth (Feet)	Lower Depth (Feet)
Line5A_GW	Line5A_GW-CW	GW	5A-MW3	5A-MW3-0718	7/24/2018	45	55
Line5A_GW	--	GW	JAW-609	JAW-609-0718	7/24/2018	102	112
Line5A_GW	Line5A_GW-CW	GW	5A-MW2	5A-MW2-0718	7/23/2018	7.5	17
Line5A_GW	Line5A_GW-CW	GW	5A-MW1	5A-MW1-0718	7/23/2018	7.5	17
Line5A_GW	Line5A_GW-CW	GW	JAW-606	JAW-606-0718	7/22/2018	5	15
Line5A_GW	Line5A_GW-CW	GW	5A-MW5	5A-MW5-0718	7/22/2018	10	20
Line5A_GW	Line5A_GW-CW	GW	5A-MW4	5A-MW4-0718	7/20/2018	10	20
Line5A_GW	Line5A_GW-CW	GW	5A-MW6	5A-MW6-0718	7/20/2018	15	25
Line5A_GW	Line5A_GW-CW	GW	5A-MW2	F04-GW-054	11/16/2004	7.5	17
Line5A_GW	Line5A_GW-CW	GW	5A-MW1	5A-MW1-20030601	6/1/2003	7.5	17
Line5B_GW	Line5B_GW-CW	GW	5B-MW3	5B-MW3-0718	7/24/2018	43	53
Line5B_GW	Line5B_GW-CW	GW	JAW-607	JAW-607-0718	7/23/2018	6.5	15.5
Line5B_GW	Line5B_GW-CW	GW	5B-MW2	5B-MW2-0718	7/23/2018	10	19.5
Line5B_GW	Line5B_GW-CW	GW	5B-MW1	5B-MW1-0718	7/23/2018	7.5	17
Line5B_GW	Line5B_GW-CW	GW	JAW-608	JAW-608-0718	7/23/2018	9	19
Line5B_GW	Line5B_GW-CW	GW	5B-MW4	5B-MW4-0718	7/22/2018	7	17
Line5B_GW	Line5B_GW-CW	GW	5B-DP1	5B-DP1-0618	6/21/2018	11.3	15
Line5B_GW	Line5B_GW-CW	GW	5B-DP2	5B-DP2-0618	6/21/2018	11.3	15
Line5B_GW	Line5B_GW-CW	GW	5B-MW1	F04-GW-060	11/17/2004	7.5	17
Line5B_GW	Line5B_GW-CW	GW	5B-MW1	5B-MW1-20030601	6/1/2003	7.5	17

Notes:

(1) The data were reduced such that when a normal and duplicate sample were available, the highest detected concentration among normal or duplicate samples was used when a chemical was detected in any sample. If both results were non-detect, the lowest reported detection limit (i.e., reporting limit) was used.

(2) Explosives data from the 2003 and 2004 samples were not used in the evaluation because more recent data were available.

GW = Groundwater

NA = Not Available

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Installation Assessment of IAAAP (USATHAMA, 1980)	1980	A records search was conducted to assess the use, storage, treatment, and disposal of toxic and hazardous materials at IAAAP regarding environmental quality.	Line 800 was an ammunition renovation facility and main metal treatment facility. Previous explosives-contaminated water treatment methods involved the accumulation in outside settling sumps via floor drains and transfer via truck to the Line 800 Leaching Pond. A follow-on preliminary survey was recommended to define the level of contaminants that may be migrating beyond the installation boundaries.
Contamination Survey (ERG, 1982)	1982	Sediment and surface water were collected from four locations (W-13 through W-16) and analyzed for explosives. Four monitoring wells (G-17 through G-20) were installed, and a groundwater sample was collected from each and analyzed for explosives.	RDX was detected in surface water and groundwater. 1,3,5-Trinitrobenzene and TNT were detected in sediment and groundwater. 1,3-Dinitrobenzene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene were also detected in groundwater. Further delineation of detected explosives was recommended.
Follow-on Study of Environmental Contamination (Battelle, 1984)	1984	Surface water and sediment samples were collected from one location each (W-40/SE-60) and analyzed for explosives and metals. Samples from five 5-foot sediment cores (SE-40 through SE-44) and one 5-foot soil core (SL-45) were collected and analyzed for explosives and metals. Four shallow and four bedrock monitoring well pairs (G-40 through G-47) were installed. Groundwater samples were collected from the eight new wells and four existing wells (G-17 through G-20) and analyzed for explosives and metals.	Explosives were detected in soil/sediment, with higher concentrations present toward the southwestern end of the lagoon, where sludge and effluent contaminated with explosives and metals were disposed. Explosives were also detected in surface water and in groundwater at lower concentrations; it was concluded that explosives in shallow groundwater was due either to leaching of contaminated sediments of the lagoon or to infiltration of much higher explosives concentrations that may have existed in the surface water of the lagoon in the past. Metals were not detected in groundwater or surface water above screening criteria. Elevated levels of some metals were detected in soil sample SL-45 and sediment sample SE-43.
Midwest Site Confirmatory Study (Dames & Moore, 1986)	1986	Groundwater samples were collected at G-17 through G-20 and G-40 through G-47 and analyzed for explosives, VOCs, and metals. A surface water sample was collected from W-40 and analyzed for explosives, VOCs, and metals.	Explosives were detected in shallow and deep groundwater at Line 800 and Pinkwater Lagoon. Elevated levels of cadmium, copper, and lead were present in surface water.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Endangerment Assessment/FS, Line 1 Impoundment and Line 800 Pinkwater Lagoon (Dames & Moore, 1989a, 1989b)	1987	Two soil samples were collected at each of five locations (SL-74 through SL-78) in settling basins and analyzed for explosives and metals. A total of 38 soil samples were collected from 13 locations (SL-61 through SL-73) in or adjacent to the lagoon and analyzed for explosives and metals. Four groundwater wells (G-48 and G-56 through G-58) were installed, and samples were analyzed for explosives and metals.	Elevated levels of explosives were present in overburden and bedrock groundwater, surface water, soil, and sediment. Elevated levels of cadmium, copper, and lead were also present in soil/sediment. Explosives and metals concentrations were generally highest in soil and sediment in the southwestern portion of the lagoon where sludge was historically dumped. Explosives concentrations decreased with depth.
Facility-wide Preliminary Assessment (JAYCOR, 1994a)	1991	A preliminary assessment was conducted for Line 800 to evaluate the potential for contamination and assess potential migration pathways and exposure potential if contamination were present.	Releases of explosives to the environment may have occurred during historical site operations at Line 800 and resulting from wastes dumped at Line 800 before the Pinkwater Lagoon was constructed. Detailed sampling of soil and groundwater was recommended to investigate the effects of past spills and discharges to the surface and to assess whether contaminants from the Pinkwater Lagoon have migrated beneath Line 800.
Facility-wide Site Inspection (JAYCOR, 1992)	1992	Based on the SI report, 13 surface and subsurface soil samples were collected around the Line 800 buildings: one each from 11-SA-01 through 11-SA-12 and a field duplicate. Samples were analyzed for metals, explosives, VOCs, SVOCs, pesticides, and PCBs, depending on sample location.	Based on the SI results, it was recommended that Line 800 be included in the Phase I RI.
Facility-wide Phase I and Follow-on Remedial Investigation Remedial Investigation (JAYCOR, 1993a, 1996)	1992–1995	Soil samples were collected from four locations around pad 800-169-2 from 0.5 foot bgs and 2.0 feet bgs and analyzed for pesticides and PCBs.	Six of the eight soil samples contained low levels (less than 0.03 µg/g) of pesticides (4,4-DDE or 4,4-DDT). Agricultural fields surrounding Line 800 were suspected to be the source of the pesticides. No PCBs were detected.
		During the Phase I RI, soil gas screening was conducted around Buildings 800-03-03, 800-03, 800-04, and 800-70-2. Thirty-five samples were collected from depths ranging from 1 to 12 feet bgs and analyzed for VOCs. During the follow-on sampling, soil gas samples were collected at two locations, R11-23 and R11-25, to verify screening results around Building 800-0302.	Very low levels of VOCs were found in 11 of the 35 Phase I RI samples. Concentrations of total VOCs ranged from 3 ppb to 11 ppb. No VOCs were detected in either of the follow-on confirmation samples.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
		A total of 46 explosives screening samples and 192 metal screening samples were collected around buildings at Line 800. Two of the explosives screening and 24 of the metals screening samples were sent to a fixed laboratory for confirmatory analysis. Soil borings were also drilled to 10 feet bgs within each of the five settling ponds northeast of the Pinkwater Lagoon, and three borings were installed in the Pinkwater Lagoon. Soil samples were collected from these borings and analyzed for VOCs, SVOCs, metals, and explosives.	Explosives were detected in screening samples around Building 800-191 and Building 800-192. No explosives were detected around Building 800-70-1, Building 800-193, Building 800-08, Building 800-68, Building 800-04, Building 800-70-2, Building 800-03, Building 800-163-1, Building 800-163-2, or Building 800-61. Metals (barium and lead) were detected in all 60 soil samples analyzed for metals around Line 800, with maximum concentrations of 651 and 1,650 ppm, respectively. Chromium was detected in 59 samples with a maximum concentration of 161 ppm. Cadmium was detected in 10 samples with a maximum concentration of 757 ppm. Arsenic, mercury, selenium, and silver were also detected with maximum concentrations below 100 ppm. Low levels of SVOCs were detected in two of the five settling ponds and in the three sample locations in the lagoon. Bis(2-ethylhexyl)phthalate was reported at the highest SVOC concentrations, with a maximum of 8.5 ppm. Explosives were detected in all five settling ponds, with maximum concentrations of 20.2 µg/g of 1,3,5-TNB, 14.3 µg/g 2,4-DNT, 11.6 µg/g of TNT, 2.1 µg/g HMX, and 0.702 µg/g RDX. In the lagoon, RDX was detected at a maximum concentration of 21.9 µg/g, TNT was detected at a maximum concentration of 21.4 µg/g, and HMX was reported at a maximum concentration of 23.8 µg/g.
		Basewide sediment/surface water samples RBW-SD/SW-59 were collected approximately 250 feet downgradient of Line 800 in an intermittent stream. Basewide sediment sample RBW-SD-60 was collected downgradient of NPDES outfall 072, 30 feet east of Building 800-71-1. Samples were analyzed for VOCs, SVOCs, metals, and explosives.	Explosives were not detected in the basewide sediment sample collected downgradient of Line 800; surface water at this location had RDX at 2.01 µg/L. Lead was detected in sediment (17.0 µg/g) and surface water (2.82 µg/L) at this location. No VOCs or SVOCs were detected. Explosives were detected in sediment sample RBW-SD-06 at a maximum concentration of 27.3 µg/g (HMX). Lead was detected at 39.0 µg/g. No VOCs or SVOCs were detected.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
		Groundwater samples were collected from 16 existing monitoring wells in the Line 800 and Pinkwater Lagoon area during Phase I RI activities and analyzed for metals, VOCs, SVOCs, and explosives. Monitoring wells JAW-78 and JAW-79 were installed during Phase II of the RI and analyzed for SVOCs and explosives.	Explosives were detected in 11 monitoring wells in Line 800, with a maximum concentration of 13,000 µg/L RDX reported in G-20, at the upgradient boundary of the lagoon. No metals were reported above 10 µg/L, and only low levels of VOCs were detected in the six wells around Line 800. Elevated metals and VOCs were reported in wells within the Pinkwater Lagoon area.
Baseline Human Health and Ecological Risk Assessment, Former Line 1 Impoundment and Pink Water Lagoon (JAYCOR, 1994b)	1994	The 1989 Endangerment Assessment report was rewritten to incorporate USEPA comments on the original document and more-current baseline risk assessment approaches that are in accordance with “Risk Assessment Guidance for Superfund Volumes I and 2,” (EPA/5401l/89/002).	The revised risk assessment concluded that soil/sediment and groundwater at Pinkwater Lagoon potentially posed risks in excess of 10^{-6}, with RDX and 2,6-DNT being the primary risk drivers.
Engineering Evaluation/Cost Analysis (EE/CA) for the Pink Water Lagoon and the Line I Impoundment (CDM, 1994)	1994	Removal action alternatives were evaluated for the Pinkwater Lagoon and the former Line 1 Impoundment areas. Non-time-critical removal actions (NTCRAs) were evaluated for these sites prior to completion of the feasibility study process to reduce human exposure and any further impact to groundwater.	The EE/CA recommended Alternative 1: excavation and storage in an RCRA waste pile for Pinkwater Lagoon. This alternative included excavation of contaminated soil and sediment and segregation based on the measured levels of contaminants. The report noted that the final remedy will be selected when the feasibility study for remedial alternatives addressing the entire site is completed.
Phytoremediation Study (USACE, 1996)	1996	A study was performed to quantify the ability of three submerged and emergent macrophytes, when planted in local sediment under flow-through conditions, to phytoremediate explosives-contaminated groundwater at IAAAP.	Recommendations for the use of aquatic and wetland plants in constructed wetlands were provided. The plants can provide a carbon supply for TNT- and RDX-degrading microorganisms. The direct removal of explosives by plant uptake and subsequent metabolization, and the possibility that plant-specific leachates photosensitize explosives and selectively stimulate explosives-degrading microorganisms, were suggested during the study but not demonstrated.
Action Memorandum for the Line 800 Pinkwater Lagoon, Former Line 1 Impoundment (CDM, 1996)	1996	The memorandum described the removal action selected for the Line 800 Pinkwater Lagoon and Former Line 1 Impoundment, and summarized the site evaluation, which supported the implementation of a removal action.	The action memorandum served as the primary decision document for the removal conducted at Line 800 and Pinkwater Lagoon and at Former Line 1 Impoundment. More than 100,000 cubic yards of explosives contaminated soil and sediment was proposed for removal at the Line 1 Impoundment and Pinkwater Lagoon. The removal action also included the diversion of Brush Creek around the Line 1 Impoundment and the creation of a wetland at each site for phytoremediation.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Interim Remedial Action for Line 800 Pink Water Lagoon (ECC, 2001a)	1996–1997	A total of 3,692 soil samples were collected during characterization, disposition, and verification phases, including QC/QC samples. All samples were analyzed for explosives. An estimated 84,880 cubic yards of contaminated soil and sediment was removed from the Line 800 Pinkwater Lagoon and associated settling basins located north and northeast of the lagoon. The excavated media were relocated to the Inert Disposal Area.	RDX concentrations in several confirmation samples exceeded the OU-1 RG leaching remediation goal of 1.3 mg/kg, however, additional excavation was not conducted per USACE direction based on the low contaminant concentrations remaining, minimal human health and ecological risks, and presence of groundwater in the excavations. Concentrations of all other explosives were below the removal goals. Operation and maintenance activities were defined in the remedial action report and included: GAC water treatment, sampling and analysis of the GAC treatment unit, phytoremediation monitoring, sampling and analysis of monitoring wells, gas vents, and gas probes, erosion control, mowing, and other maintenance.
Interim Action Record of Decision for Soils Operable Unit (USAEC, 1997)	1997	The selected interim remedial actions for contaminated soils at 15 areas at IAAAP were presented.	The Interim Action ROD specified that the most highly contaminated soils, which included the Line 1 Impoundment and Pinkwater Lagoon, will be stockpiled in the onsite Corrective Action Management Unit.
Phytoremediation Monitoring Line 1 and Line 800 (Phytoworks, 1999)	1998	Baseline sampling was conducted in sediment, surface water, and plant tissue to assess whether phytoremediation was occurring at the former Line 1 Impoundment and Line 800 and Pinkwater Lagoon. Seventeen samples were collected from sediment in the Line 800 lagoon area and analyzed for explosives. Plant and water samples also were collected, but information on number of samples and analysis is limited. A sample location map is not available.	The data indicated plant species at Lines 1 and 800 were destroying TNT and its degradation products, but although plants were concentrating RDX and HMX, the data about whether the plants were destroying or simply sequestering RDX and HMX were inconclusive. RDX was detected in all sediment samples with results ranging from 200 to 7,250 µg/kg. HMX, 4-amino-2,6-DNT, 2-amino-4,6-DNT, and TNT were also detected in one or more sediment samples, although at lower concentrations than RDX.
Record of Decision for Soils OU-1 (USAEC, 1997; Harza, 1998)	1998	The final ROD for OU-1 was issued to address contaminated soils at IAAAP. The ROD presented the selected remedial action for OU-1.	The selected remedy included excavation for soil contaminated with metals and explosives at Line 800.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Supplemental Remedial Investigation Line 800/Pink Water Lagoon (MWH, 2001)	1998–2000	Twenty-six monitoring wells (800-MW1 through 800-MW26) were installed, 16 in the overburden and 10 in the bedrock. Groundwater samples were collected at the 26 new wells and 18 existing wells over four monitoring events between 1998 and 2000 and analyzed for explosives and eight RCRA metals. A subset of wells were also analyzed for VOCs.	High concentrations of explosives, primarily RDX and TNT, were detected around the lagoon. The lateral and vertical extent of the explosives plume was considered defined, with no impacts above screening levels (equal to the EPA MCL/RSL or HAL at the time of the report) observed in bedrock during the last and most comprehensive sampling conducted in 2000. Elevated levels of arsenic, chromium, and lead were detected in several wells during the 1999 sampling (where samples had high turbidity), but only lead exceeded the screening levels in the 2000 sampling at G-46 (which had not had elevated concentrations previously) and 800-MW22. The SRI concluded that metals did not appear to be chemicals of concern at the Pinkwater Lagoon, but additional monitoring was recommended. VOC concentrations did not exceed PRGs.
		Five surface water samples (800-CK01 through 800-CK05) were collected from tributaries upstream of and drainages exiting downstream of the lagoon and analyzed for explosives.	Low levels of explosives were detected in four of the five surface waters. Concentrations did not exceed the site characterization PALs.
		Three sediment samples and three groundwater seepage samples (800-CK01 through 800-CK03) were collected from a tributary north of the lagoon and analyzed for explosives and metals.	TNT was detected in one sediment sample at 1,100 µg/kg. RDX was detected in one groundwater seepage sample at 3.2 µg/L. Metals were detected in sediment samples; however, only selenium exceeded the site background levels identified in the RI (JAYCOR, 1996).
		One sludge sample was collected from 13 feet bgs into the soil in what appeared to be a former settling basin that had been part of a removal action north of the lagoon. The sample was analyzed for explosives.	TNT was detected in the sludge sample at a concentration of 43,000 mg/kg, indicating that remnants of a former settling basin are present to depths of 14 feet bgs. The sludge-like material is underlain by clean sand fill. The lateral extent of this material appears to be less than about 10 feet.
		Hydraulic conductivity slug tests were conducted in 21 wells.	Average hydraulic conductivities in the shallow and deep overburden were 5.0×10^{-4} cm/sec and 7.4×10^{-5} cm/sec, respectively.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Periodic Groundwater Monitoring (multiple reports)	1998–2006	Periodic groundwater sampling was conducted at Line 800 and Pinkwater Lagoon to provide additional data for sites that had not been the subject of remediation work at the time of sampling. This work was often conducted coincident with the SRI (MWH 2001). Samples were analyzed for VOCs, explosives, perchlorate, and metals, depending on the sampling event.	VOCs, explosives, and metals were detected in groundwater samples collected from wells screened within the shallow zone of the overburden aquifer. The explosive RDX was also detected above its screening level in the intermediate zone of the overburden aquifer. During the last large sampling event, in 2004, the highest concentration of RDX was reported at 17,000 µg/L. Total manganese was detected at a maximum concentration of 2,230 µg/L, and 1,2-dichlorethane was detected at a maximum concentration of 6.2 µg/L. Because of an ongoing treatability study, only perchlorate was analyzed for during the last sampling event in 2006; perchlorate was not detected.
Sump Removal Action at Building 800-192 (ECC, 2001b)	1999	Prior to the removal action, 48 soil samples were collected at the Building 800-188 sump site and 35 soil samples were collected at the Building 800-192 sump site to define the excavation areas. Samples were analyzed for explosives and RCRA metals. The sump and approximately 20 cubic yards of soil contaminated with explosives were removed from the sump area at Building 800-192.	Four-point confirmation samples were taken from the sidewalls and the bottom of the excavation at Building 800-192. Confirmation data indicated the sump excavations removed all soil above screening levels.
Period Surface Water Lagoon Sampling (URS, 2003b)	1999–2001	Monthly surface water samples were collected from the lagoon to monitor the success of treating explosives-contaminated groundwater using wetland plant species.	The concentration data indicated successful reduction of explosives concentrations to nondetect levels in the surface water of the lagoon during the summer months. During the winter months, the RDX concentrations rose, but generally to levels less than 10 µg/L. The degradation of explosives in the lagoon was believed to result from the synergistic combination of photolysis, plants, and waterborne and soil microorganisms.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Groundwater Flow and Contaminant Fate and Transport Modeling (URS, 2003a)	2003	Groundwater flow and contaminant fate and transport modeling was conducted to support a groundwater FS for the Line 800 Pinkwater Lagoon. Groundwater flow and contaminant fate and transport was modeled using the MODFLOW and MT3DMS numerical computer modeling programs, respectively. The model was used to evaluate the effectiveness of various remedial alternatives for the FS.	The modeling results indicated a no action alternative for groundwater contamination at the Line 800 and Pinkwater Lagoon would result in the explosives plume discharging to the Brush Creek tributary at concentrations above the PRGs (equal to the EPA MCL/RSL or HAL at the time of the report). Results indicated that the permeable reactive barrier, interceptor trench, and groundwater restoration alternatives would eliminate the discharge of the explosives plume to the Brush Creek tributary at concentrations above PRGs. Furthermore, model results indicated that the groundwater restoration alternative did not significantly decrease the overall cleanup time for site groundwater compared to the PRB and interceptor trench alternatives.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech, 2006b)	2005	A comprehensive evaluation was conducted of all IAAAP sites and the four primary watersheds (Brush Creek, Spring Creek, Long Creek, and Skunk River) to identify data gaps and additional data needed to complete a feasibility study for surface water and groundwater at each of the IAAAP sites.	The work plan concluded that contaminants in soil and groundwater were adequately characterized. There was uncertainty whether the Line 800 tributary was contributing to contamination at Brush Creek. It was recommended that an additional sampling point be added to the periodic monitoring program to assess this data gap.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Groundwater Treatability Study (Tetra Tech, 2009a, 2012a)	2005–2009	Two groundwater treatability studies were conducted at Line 800 to test the efficacy of enhanced in situ bioremediation at reducing the highest concentrations of RDX to levels that could be further remediated using natural attenuation. A small-scale treatability study was conducted from 2005 to 2006; only Phase 1 of the study was implemented. Five small-diameter monitoring wells (L800-TT-MW01 through -MW05) were installed. The first round of HFCS injections was conducted in a 2,500-ft^2 test area on the east side of Pinkwater Lagoon in May 2005; the second round of injections was conducted in December 2005 and January 2006. Six monitoring wells were sampled as part of the study and analyzed for RDX and degradation products, total iron and manganese, sulfate, nitrate, nitrite, carbon dioxide, methane, and total organic carbon. A full-scale treatability study was conducted from 2007 to 2009. HFCS was injected at 94 injection locations at Line 800, and an additional 14 monitoring wells (L800-TT-MW06 through L800-TT-MW19R) were installed to supplement performance monitoring. Approximately 300 gallons of a 20-percent HFCS solution were injected into boreholes in October and November 2007. Twenty-seven monitoring wells were sampled as part of the study and analyzed for RDX and degradation products, total iron and manganese, sulfate, nitrate, nitrite, and total organic carbon.	During the small-scale study, concentrations of RDX and TNT decreased more than an order of magnitude in the test area. During the large-scale study, concentrations of explosives also decreased over the majority of the study area. It was concluded that the addition of a carbon amendment enhanced the natural degradation process of explosives in groundwater across the site. By fall 2009, concentrations had largely decreased except in a few remaining hot spots, where they had increased or remained largely the same. Additional injections were recommended at Line 800.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Remedial Action Completion Report for OU1 Soils Phase 5, 7, and 8 Sites (Tetra Tech 2009a, 2012a)	2005–2007	5,215 yd^3 of contaminated soil were removed from 12 excavation areas near five buildings, a waste line, a ditch, and Pinkwater Lagoon as part of the OU-1 remedial action. One excavation area (L800-E8) was halted at 12 feet bgs to prevent compromising active railroad tracks and the lagoon berm. While backfilling this excavation area, HFCS was diluted and added at a depth of approximately 4 feet to promote bioremediation of explosives in groundwater. This excavation area was located near monitoring well 800-MW5, which was later replaced with L800-TTMW-019R.	Based on confirmation sampling, soil with concentrations above OU-1 RGs was removed with one exception. Confirmation samples at excavation area (L800-E8) showed RDX and TNT above the OU-1 RGs for leachability. It was noted that the elevated concentrations for TNT were below the maximum construction exposure depth of 10 feet bgs. The residual RDX concentrations were overlain and underlain by soils containing residual RDX concentration significantly below the RG, suggesting that the potential for vertical leaching of low residual RDX through the dense clay underlying and surrounding L800-E08 is unlikely. The HFSC added to the L800-E8 excavation area resulted in explosives concentrations in the adjacent groundwater monitoring well being reduced to below screening levels within 1 year.

Table 5.7-1. Previous Investigations and Remedial Actions—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Line 1 Impoundment and Line 800 Lagoon Operations and Maintenance Plan (Aerostar, 2016)	2016	It was determined that regular O&M activities are required to sustain the proper functionality of the interim remedial actions at the Line 1 Impoundment and Pinkwater Lagoon. This plan provided detailed information for O&M activities, standard operating procedures, email notifications.	The following O&M activities were planned for the Line 800 Lagoon Impoundment: • Water surface elevation within the Line 800 Lagoon Impoundment will be evaluated weekly and after significant rain events. • A four-point composite water sample will be collected from the lagoon for offsite laboratory analysis to determine whether a direct release or a treatment system release should be conducted. • If a direct release occurs, then weekly sampling should be conducted at the point of discharge. • If a treatment release is conducted, then weekly sampling should be conducted from the effluent sampling port. Monthly samples should be collected from the influent port and after the first carbon unit. Bag filter sampling and spent carbon sampling may also be needed. • O&M activities should also be conducted on the remedial action structures. • The Line 800 Lagoon will be inspected annually to identify required activities to maintain the integrity of the constructed features.
Explanation of Significant Differences for the Records of Decision Soils OU-1 (Leidos, 2018)	2018	Documented the addition of LUCs to the selected remedy for the soils ROD to provide overall protectiveness of human health and the environment.	The Explanation of Significant Differences changes will apply to soil at Line 800.
OU-1 Land Use Controls Implementation Plan (Leidos, 2019)	2019	Outlined the process for implementation and maintenance of LUCs as a component of the selected remedy for OU-1. Institutional controls will be used to restrict land use at OU-1 areas to military, commercial/industrial, agricultural, and permitted hunting and prohibit residential use. Engineering controls (fencing, signs) will be used to prevent general access to areas.	The scope of the LUCIP applies to Line 800.

Table 5.7-3. Monitoring Well Construction Details—Line 800

Iowa Army Ammunition Plant, Middletown, IA

Well Location	Screen Interval (feet bgs)	Filter Pack Interval (feet bgs)	Borehole Depth (feet bgs)	Well Casing Diameter (inches)	Top of Casing Elevation (feet amsl)
800-MW27	10 to 20	8 to 20	20	2	686.95
800-MW28	10 to 20	9 to 10	20	2	686.13
800-MW29	10 to 20	8 to 20	20	2	683.9
800-MW30	10 to 20	8 to 20	10	2	684.5
800-MW31	10 to 20	8 to 20	10	2	686.22

Notes:

Borehole diameter was 8 inches for all monitoring wells.

amsl = above mean sea level

bgs = below ground surface

Table 5.7-4. Gauging Information—Line 800

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval (ft btoc)	Depth to Water (ft btoc)	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)
800-MW-1	8/14/2018	10 - 20	11.17	684.71	673.54
800-MW-10	8/14/2018	7.5 - 17.5	10.3	681.25	670.95
800-MW-11	8/14/2018	66.2 - 76.2	22.19	681.33	659.14
800-MW-12	8/14/2018	7.5 - 17.5	11.4	687.37	675.97
800-MW-13	8/14/2018	7.5 - 17.5	11.6	686.06	674.46
800-MW-14	8/14/2018	25 - 35	12.02	685.72	673.7
800-MW-15	8/14/2018	7.5 - 17.5	11	682.14	671.14
800-MW-16	8/14/2018	60.5 - 70.5	NM	679.59	NA
800-MW-17[a]	8/14/2018	24.5 - 34.5	NM[a]	679.55	NA
800-MW-18	8/14/2018	7.5 - 17.5	9.95	681.86	671.91
800-MW-19	8/14/2018	64 - 74	65.7	680.67	614.97
800-MW-2	8/14/2018	66 - 76	18.18	682.72	664.54
800-MW-20	8/14/2018	7.5 - 17.5	14.57	678.81	664.24
800-MW-21	8/14/2018	67 - 77	23.2	682.17	658.97
800-MW-22	8/14/2018	54 - 64	14.62	682.34	667.72
800-MW-23	8/14/2018	54 - 64	12.83	684.73	671.9
800-MW-24	8/14/2018	67 - 77	21.03	680.54	659.51
800-MW-25	8/14/2018	7.5 - 17.5	10.05	681.96	671.91
800-MW-26	8/14/2018	7 - 17	10.25	682.53	672.28
800-MW27	8/14/2018	11 - 21	11.46	686.951	675.491
800-MW28	8/14/2018	11 - 21	11.17	686.139	674.969
800-MW29	8/14/2018	11 - 21	13.19	683.909	670.719
800-MW-3	8/14/2018	69 - 79	27	682.63	655.63
800-MW30	8/14/2018	11 - 21	13.45	684.504	671.054
800-MW31	8/14/2018	11 - 21	11.35	686.224	674.874
800-MW-4	8/14/2018	64 - 74	20.33	685.92	665.59
800-MW-5[a]	8/14/2018	7.5 - 17.5	NM[a]	678.8	NA
800-MW-6	8/14/2018	7.5 - 17.5	12.02	681.54	669.52
800-MW-7	8/14/2018	27.5 - 37.5	10.84	682.64	671.8
800-MW-8	8/14/2018	7.5 - 17.5	9.45	685.38	675.93
800-MW-9	8/14/2018	7.5 - 17.5	10.25	685.59	675.34
G-17	8/14/2018	9 - 19	14.35	684.209	669.859
G-18	8/14/2018	9 - 19	10.83	682.791	671.961
G-19	8/14/2018	9.5 - 19.5	11.45	683.403	671.953
G-20	8/14/2018	9.5 - 19.5	13.09	685.775	672.685
G-40	8/14/2018	73 - 83	46	684.08	638.08
G-41	8/14/2018	9.8 - 19.8	8.42	684.228	675.808
G-42	8/14/2018	66.5 - 76.5	27.17	685.27	658.1
G-43	8/14/2018	32 - 42	22.49	685.596	663.106
G-44	8/14/2018	68 - 78	22.28	682.016	659.736
G-45	8/14/2018	30 - 40	12.72	681.378	668.658
G-46	8/14/2018	58 - 68	11.24	680.444	669.204
G-47	8/14/2018	16 - 26	10.68	680.59	669.91
G-48	8/14/2018	20 - 30	32.98	683.105	650.125
G-56	8/14/2018	18.5 - 28.5	9.59	681.9	672.31
G-57	8/14/2018	20 - 30	7.83	682.443	674.613
G-58	8/14/2018	20 - 30	11.39	683.375	671.985
JAW-78	8/14/2018	50 - 65	10.94	677.706	666.766
JAW-79	8/14/2018	25 - 35	8.93	677.74	668.81
L800-TT-MW01	8/14/2018	1 - 6.5	7.4	NM	NA
L800-TT-MW04	8/14/2018	20 - 25	7.23	NM	NA

Table 5.7-4. Gauging Information—Line 800

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval (ft btoc)	Depth to Water (ft btoc)	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)
L800-TT-MW09	8/14/2018	5 - 30	8.87	NM	NA
L800-TT-MW15	8/14/2018	10 - 35	18.82	NM	NA
L800-TT-MW18	8/14/2018	7.5 - 27.5	8.44	NM	NA

Notes:

ft = feet

btoc = below top of casing

amsl = above mean sea level

NA = Not Available

NM = Not Measured

[a]Well could not be located

Table 5.7-5. Detected Chemicals in Surface Water—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	LAGOON.1	LAGOON.2	LAGOON.3	LAGOON.4
					Sample ID	LAGOON.1-20010617	LAGOON.2-20010617	LAGOON.3-20010617	LAGOON.4-20010617
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	6/17/2001	6/17/2001	6/17/2001	6/17/2001
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95(1))				
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.89 U	1.4 U	0.63 U	0.62 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	13	--	0.71 U	1.2 U	0.51 U	0.49 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	18	--	0.71 U	1.2 U	0.51 U	0.49 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	11	--	0.71 U	1.2 U	0.51 U	0.49 U
EXPLOSIVES	2691-41-0	HMX	μg/L	220	--	1.2	1.3	1.1	1
EXPLOSIVES	121-82-4	RDX	μg/L	79	--	1.4	1.5	1	1.1
METALS	7429-90-5	Aluminum	μg/L	87	5900	- -	- -	- -	- -
METALS	7440-36-0	Antimony, dissolved	μg/L	190	4	- -	- -	- -	- -
METALS	7440-38-2	Arsenic	μg/L	11.7	8	3.4 J	5.2 J	5.6 J	6.7 J
METALS	7440-39-3	Barium	μg/L	220	236	17.3 J	19.6 J	17.8 J	20.1 J
METALS	7440-39-3	Barium, dissolved	μg/L	220	210	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	64.1	0.4	0.3 U	0.3 U	0.3 U	0.3 U
METALS	7440-70-2	Calcium	μg/L	116000	--	- -	- -	- -	- -
METALS	7440-70-2	Calcium, dissolved	μg/L	116000	--	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	0.66	6.4	1.3 UJ	0.9 UJ	0.9 UJ	1.1 UJ
METALS	7440-47-3	Chromium, dissolved	μg/L	0.66	8	- -	- -	- -	- -
METALS	7440-48-4	Cobalt	μg/L	19	1.4	- -	- -	- -	- -
METALS	7440-50-8	Copper	μg/L	1000	5.4	- -	- -	- -	- -
METALS	7440-50-8	Copper, dissolved	μg/L	1000	4.6	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	1000	4700	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	--	3.3	2.9 J	3 J	3.7 J	3 J
METALS	7439-95-4	Magnesium	μg/L	82000	--	- -	- -	- -	- -
METALS	7439-95-4	Magnesium, dissolved	μg/L	82000	--	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	93	120	- -	- -	- -	- -
METALS	7439-96-5	Manganese, dissolved	μg/L	93	170	- -	- -	- -	- -
METALS	7440-02-0	Nickel	μg/L	4600	5	- -	- -	- -	- -
METALS	7440-09-7	Potassium	μg/L	53000	--	- -	- -	- -	- -
METALS	7440-09-7	Potassium, dissolved	μg/L	53000	--	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	5	2.4	2.8 J	4.1 J	2.2 J	3.4 J
METALS	7440-22-4	Silver, dissolved	μg/L	4020	1.8	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	680000	--	- -	- -	- -	- -
METALS	7440-23-5	Sodium, dissolved	μg/L	680000	--	- -	- -	- -	- -
METALS	7440-28-0	Thallium, dissolved	μg/L	0.47	1.8	- -	- -	- -	- -
METALS	7440-62-2	Vanadium	μg/L	27	12	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	26000	18	- -	- -	- -	- -
METALS	7440-66-6	Zinc, dissolved	μg/L	26000	15	- -	- -	- -	- -

Notes:

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

B = The analyte was detected in the associated method and/or calibration blank.

E = Sample result over the calibration range, considered an estimated result.

P = Sample failed confirmation precision criteria.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

μg/L = micrograms per liter

Table 5.7-5. Detected Chemicals in Surface Water—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, IA

					Location	LAGOON.1	LAGOON.2	LAGOON.3	LAGOON.4
					Sample ID	LAGOON.1-20010617	LAGOON.2-20010617	LAGOON.3-20010617	LAGOON.4-20010617
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	6/17/2001	6/17/2001	6/17/2001	6/17/2001
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])				

-- = Not Analyzed

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable

*Screening level is the lower of the selected Human Health and Ecological screening levels (see Appendix F).

Source: EPA's Regional Screening Levels (September 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: Background threshold values (BTVs) from *Evaluation of Background Concentrations of Metals in Sediment and Surface Water* (CH2M, 2020b)

[1] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-1							
					Sample ID	800MW01-010600	800-MW-1-051100	800-MW-1-20001121	800-MW-1-20010618	800-MW-1-20020628	800-MW-1-20040618	F04-GW-043	800-MW-1-FBL
					Sample Depth (ft)	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9
					Sample Date	1/6/2000	5/11/2000	11/21/2000	6/18/2001	6/28/2002	6/18/2004	11/15/2004	9/23/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**255000**	- -	**240000**	**280000**	**280000**	**250000**	**300000**	**300000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**440**	- -	**80**	10 U	**10**	40 U	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**252000**	- -	**32000**	**90000**	**120000**	**45000**	**3300**	**565000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	**160**	- -	1000 U	1000 U	1000 U	1000 U	1000 U	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	1000 U	1000 U	1000 U	1000 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**1800**	- -	300 U	300 U	300 U	1000 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	**2100**	1000 U	**1200**	1000 U	1000 U	**13100**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**12900**	- -	**13000**	**8000**	**9000**	**12000**	**6000**	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	***16000***	***26000***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	***47900***	- -	***39000***	***18000***	***21000***	***60000***	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	100 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**27400**	- -	**140000**	**25000**	**27000**	**32000**	**28000**	**32600**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	**0.32**	**0.16 J**	0.82 U	0.58 U	**0.92 J**	**0.25 J**	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.71 U	**0.78 J**	**0.49 J**	**0.33 J**	**0.52 J**	**0.46**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	2.3 U	0.25 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.25 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.5 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.74 U	0.5 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.5 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.06 U	0.5 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.21 U	0.5 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.06 U	1.2 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	**0.73**	**1.2**
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.53 U	**0.09 J**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	2.8 U	**1.2**	0.71 U	**0.47 J**	0.58 U	0.49 U	**0.6**	**0.62**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.25 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	6.2 U	***5.9***	***7.3***	***9.8***	***16***	***16***	***21***	***19.5***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.03 U	0.5 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	2.4 U	- -	10 U	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**140**	**190**	- -	**108 J**	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	- -	5 U	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**107000**	- -	**101000**	**80100**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	4 U	**4.1 J**	- -	10 U	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	330 U
METALS	7439-92-1	Lead	µg/L	15	18.05	3.4 U	**3.8 J**	- -	**3.7 J**	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**46500**	- -	**43400**	**38100**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	1.5 B
METALS	7439-97-6	Mercury	µg/L	2	1	0.09 U	0.1 U	- -	0.21 U	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	- -	10 U	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	3 U	2.8 U	- -	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**10300**	- -	**8580**	**6590**	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.25 U	0.71 U	0.82 U	0.58 U	0.49 U	0.53 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	**1 J**	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.87 U	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-1						800-MW-10	
					Sample ID	800-MW1-F01R1	L800-MW-1-F01R2	800-MW1-F01R3	L800-MW01-F01R5	L800-MW-01-F01R6	L800-MW1-0818	800MW10-010400	800MW10D-010400
					Sample Depth (ft)	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	9.9 - 19.9	7.5 - 17.5	7.5 - 17.5
					Sample Date	12/2/2007	1/9/2008	2/14/2008	5/21/2008	9/29/2008	8/18/2018	1/4/2000	1/4/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95(1))**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**333000**	**310000**	**300000**	**385000**	**350000**	- -	- -	**237000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	100 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**375000**	**330000**	**366000**	**476000**	**437000**	- -	- -	**256000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	**410**
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	200 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	100 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	950 B	**43000**	**42000**	930 B	**1100**	- -	- -	620 U
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	**24700**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	***47400***	**4900**	***29800***	**3100**	**8000**	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	**4500**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	***2800***	***2000***	50 U	50 U	50 U	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**34900**	**32300**	**31800**	**29200**	**26700**	- -	- -	**35200**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.1 U	0.03 U	- -
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	0.1 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**0.44**	**0.53**	**0.34**	**0.37**	**0.37**	**0.33 J**	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.1 U	0.04 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.1 U	0.05 U	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.1 U	0.05 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.1 U	0.03 U	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.21 U	0.06 U	- -
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.21 U	0.06 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.1 U	0.02 U	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.21 U	0.06 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**1.3**	**0.67**	**0.31**	**0.32**	**0.44**	**0.78**	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	**0.1 J**	**0.14 J**	**0.053 J**	**0.066 J**	**0.083 J**	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	**0.49**	**0.19 J**	**0.54**	**0.44**	**0.18**	0.06 U	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.1 U	0.06 U	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***24.1***	***16.1***	***5.2***	***10.1***	***11.4***	***18***	0.05 U	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.1 U	0.03 U	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	2.7 U
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	**134**
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	0.64 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	**68300**
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	**24.2**
METALS	7439-89-6	Iron	µg/L	14000	9736	15 U	15 U	15 U	15 U	26.7 B	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	2.1 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	**20000**
METALS	7439-96-5	Manganese	µg/L	430	579.7	1.2 B	1.8 B	1.8 B	1 B	1 U	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	0.06 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	2.9 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	2 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	**17800**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	- -	0.02 U	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	0.5 U	0.5 U	0.5 U	0.5 U	**0.28 J**	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-10						
					Sample ID	800-MW-10-050300	800-MW-10-20001121	800-MW-10-20010616	800-MW-10-20020618	800-MW-10-20040607	F04-GW-022	800-MW-10-FBL
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	5/3/2000	11/21/2000	6/16/2001	6/18/2002	6/7/2004	11/12/2004	3/20/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	- -	**250000**	**260000**	**240000**	**260000**	**240000**	**145000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	10 U	10 U	10 U	40 U	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	**95000**	**550000**	**110000**	**85000**	**5300**	**287000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	1000 U	1000 U	1000 U	1000 U	1000 U	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	1000 U	1000 U	**8000**	1000 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	300 U	300 U	300 U	1000 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	- -	**1100**	1000 U	**2800**	1000 U	1000 U	**4400**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	**19000**	**16000**	**19000**	**14000**	**16000**	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	**1600**	**9800**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	**2900**	**2500**	**2300**	**1200**	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	- -	- -	100 U	**270**
ANIONS	14808-79-8	Sulfate	μg/L	--	--	- -	**32000**	**29000**	**31000**	**30000**	**33000**	**25400**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.16 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	- -	0.75 U	0.75 U	2 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.16 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.16 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.31 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.31 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.31 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.31 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.31 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.78 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	- -	- -	- -	- -	0.49 U	0.19 U
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	- -	- -	- -	0.49 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.39 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.16 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.16 U	0.71 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.31 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	2.4 U	- -	10 U	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	**116**	- -	**120 J**	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	0.4 U	- -	5 U	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	**83800**	**80900**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	**5.8 J**	- -	**2 J**	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	225 B
METALS	7439-92-1	Lead	μg/L	15	18.05	1.7 U	- -	10 U	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	**22700**	**22600**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	**241**
METALS	7439-97-6	Mercury	μg/L	2	1	0.1 U	- -	0.21 U	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	2.6 U	- -	**2.5 J**	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	2.8 U	- -	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	**14900**	**14600**	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.16 U	0.75 U	0.6 U	1.6 U	0.49 U	0.49 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	0.87 U	0.5 U
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	3 U	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-11					
					Sample ID	800MW11-010400	800-MW-11-050300	800-MW-11-20001121	800-MW-11-20010616	800-MW-11-20020618	800-MW-11-20040607
					Sample Depth (ft)	66.2 - 76.2	66.2 - 76.2	66.2 - 76.2	66.2 - 76.2	66.2 - 76.2	66.2 - 76.2
					Sample Date	1/4/2000	5/3/2000	11/21/2000	6/16/2001	6/18/2002	6/7/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**						
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**425000**	- -	**420000**	**452000**	**440000**	**420000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**440**	- -	**210**	**260**	**320**	**230 J**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**387000**	- -	**68000**	**300000**	**190000**	**100000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	**150**	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	**3800**	1000 U	**10000**	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	- -	**600**	**300**	**500**	1000 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	**1600**	**1500**	**1200**	**1500**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**5300**	- -	1000 U	1000 U	1000 U	**1000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	**40**	**10**	10 U	50 U
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**9400**	- -	**4400**	**3000**	**3000**	**4000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	1.4 U	0.87 U	0.52 U	0.48 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.05 U	0.31 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.56 U	0.31 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.29 U	0.31 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.06 U	0.78 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	1.4 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.05 U	0.16 U	1.3 U	0.7 U	0.42 U	0.48 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.3 U	0.31 U	1.4 U	0.7 U	0.42 U	0.48 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	2.4 U	- -	10 U	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**147**	**156**	- -	**151 J**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	- -	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**93400**	- -	**95000**	**90200**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	15.1 U	**21.9**	- -	10 U	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	2.4 U	1.7 U	- -	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**39800**	- -	**43300**	**44300**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.07 U	0.1 U	- -	0.21 U	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	- -	10 U	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	2.8 U	- -	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**22000**	- -	**17700**	**18500**	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	1.4 U	0.7 U	0.42 U	0.48 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	3 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	9 U	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	3 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	3 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	3 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	10 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	3 U	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	10 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	3 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-12						
					Sample ID	800MW12-011700	800-MW-12-051100	800-MW-12-20001024	800-MW-12-20010607	800-MW-12-20020627	800-MW-12-20040607	800MW-12-F01R1
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	1/17/2000	5/11/2000	10/24/2000	6/7/2001	6/27/2002	6/7/2004	12/18/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**239000**	- -	**240000**	**220000**	**240000**	**240000**	**800000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	100 U	- -	10 U	10 U	10 U	**70**	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**218000**	- -	**30000**	**50000**	**110000**	**40000**	**896000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	530 U	- -	1000 U	1000 U	1000 U	1000 U	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	**1700**	- -	**3400**	1000 U	1000 U	1000 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	290 U	- -	300 U	300 U	300 U	1000 U	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	1000 U	1000 U	1000 U	1000 U	**39500**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2300**	- -	**2300**	**2000**	**2000**	**6000**	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	***14800***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**3300**	- -	**4600**	**4200**	**4600**	**9200**	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	***1700***
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**26400**	- -	**28000**	**24000**	**26000**	**26000**	**31900**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.95 U	0.79 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.26 U	0.31 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.06 U	0.31 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.02 U	0.31 U	0.95 U	0.64 U	0.75 U	0.49 U	**0.55**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.06 U	0.78 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.05 U	0.16 U	0.89 U	0.64 U	0.75 U	0.49 U	**1.3**
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.03 U	0.31 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	2.4 U	- -	10 U	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**144**	**175**	- -	**113 J**	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	- -	5 U	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**60300**	- -	**58700**	**58300**	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**5.4**	**10.5**	- -	**1.5 J**	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	15 U
METALS	7439-92-1	Lead	µg/L	15	18.05	**1.8**	**6.4**	- -	10 U	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**28500**	- -	**26100**	**27400**	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	2.5 B
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	- -	0.21 U	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	- -	10 U	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	- -	10 U	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**8700**	- -	**7320**	**7050**	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.95 U	0.64 U	0.75 U	0.49 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	**18**	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	10 U	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.5 U
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	10 U	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-12						800-MW-13	
					Sample ID	L800-MW12-F01R2	L800-MW12-F01R3	800-MW-12-F01R4	L800-MW12-F01R5	L800-FMW12-0818	L800-MW12-0818	800MW13-011200	800-MW-13-051100
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	1/16/2008	2/22/2008	3/19/2008	5/21/2008	8/18/2018	8/18/2018	1/12/2000	5/11/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**247000**	**389000**	**380000**	**318000**	- -	- -	**268000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	100 U	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**307000**	**468000**	**486000**	**476000**	- -	- -	**239000**	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	320 U	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	**1600**	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	100 U	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**33500**	**42900**	**43900**	**1000**	- -	- -	620 U	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	**1800**	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	***10600***	***13900***	**9600**	**9200**	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	***11200***	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	***1500***	50 U	50 U	50 U	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**31500**	**28600**	**28200**	**27600**	- -	- -	**34500**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	0.03 U	0.18 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	0.1 U	0.1 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	0.04 U	0.18 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	0.05 U	0.18 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	0.05 U	0.36 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	0.03 U	0.36 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.19 U	0.19 U	0.19 U	0.19 U	0.21 U	0.21 U	0.06 U	0.36 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.19 U	0.19 U	0.19 U	0.19 U	0.21 U	0.21 U	0.07 U	0.36 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**0.44**	**0.41**	**0.36**	**0.26**	**0.23**	**0.22**	0.02 U	0.36 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.19 U	0.19 U	0.19 U	0.19 U	0.21 U	0.21 U	0.06 U	0.91 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.19 U	0.19 U	0.19 U	0.19 U	0.21 U	0.21 U	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.19 U	0.19 U	0.19 U	0.19 U	**0.14 J**	**0.13 J**	0.06 U	0.45 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	0.06 U	0.18 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	**0.74**	**0.68**	**0.56**	**0.48**	**1**	**0.99**	0.05 U	0.18 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.1 U	0.03 U	0.36 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	27 U	**4.7 J**
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	**110**	**222**
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	0.64 U	0.4 U
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	**803**	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	**1.7**	**19.6**
METALS	7439-89-6	Iron	μg/L	14000	9736	298 B	15 U	15 U	15 U	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	1.4 U	**7.6**
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	**34000**	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	**18**	3.9 B	2.9 B	1.1 B	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	0.06 U	0.1 U
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	2.9 U	**3.3 J**
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	1.1 U	2.8 U
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	**9500**	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.19 U	0.19 U	0.19 U	0.19 U	- -	- -	0.02 U	0.18 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	0.5 U	0.5 U	**0.21 J**	0.5 U	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-13							800-MW-14
					Sample ID	800-MW-13-20001024	800-MW-13-20010618	800-MW-13-20020627	800-MW-13-20040608	F04-GW-044	800-MW-13-FBL	L800-MW13-0818	800MW14-010400
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	25 - 35
					Sample Date	10/24/2000	6/18/2001	6/27/2002	6/8/2004	11/15/2004	3/20/2007	8/19/2018	1/4/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**300000**	**270000**	**260000**	**240000**	**250000**	**215000**	- -	**457000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	10 U	10 U	40 U	- -	- -	- -	**290**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**38000**	**150000**	**110000**	**45000**	**5500**	**345000**	- -	**426000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	**640**
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	200 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	300 U	1000 U	- -	- -	- -	100 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	**5000**	- -	620 U
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**1100**	**1000**	**1000**	1000 U	1000 U	- -	- -	**3700**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	**1500**	**1500**	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**6700**	**4600**	**2300**	**1600**	- -	- -	- -	***20900***
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	100 U	**470**	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**32000**	**38000**	**36000**	**33000**	**30000**	**27500**	- -	**12400**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	0.03 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	0.1 U	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.73 U	0.52 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	0.04 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	0.05 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	0.05 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	0.03 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.2 U	0.06 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.2 U	0.52 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	0.02 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.2 U	0.06 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	0.5 U	0.19 U	0.2 U	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	0.5 U	0.19 U	0.1 U	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	**6.8**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	0.06 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.68 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	***35***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	0.1 U	0.03 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	10 U	- -	- -	- -	- -	- -	**30.2**
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**88.3 J**	- -	- -	- -	- -	- -	**522**
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	5 U	- -	- -	- -	- -	- -	0.64 U
METALS	7440-70-2	Calcium	µg/L	--	119033	**72200**	**66200**	- -	- -	- -	- -	- -	**174000**
METALS	7440-47-3	Chromium	µg/L	100	31	- -	**0.8 J**	- -	- -	- -	- -	- -	***134***
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	20.9 B	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	10 U	- -	- -	- -	- -	- -	***34.6***
METALS	7439-95-4	Magnesium	µg/L	--	45243	**29100**	**29800**	- -	- -	- -	- -	- -	**56400**
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	**254**	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.21 U	- -	- -	- -	- -	- -	0.19 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	10 U	- -	- -	- -	- -	- -	2.9 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	10 U	- -	- -	- -	- -	- -	1.1 U
METALS	7440-23-5	Sodium	µg/L	--	42581	**7510**	**7070**	- -	- -	- -	- -	- -	**19600**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.73 U	0.42 U	0.7 U	0.49 U	0.5 U	0.19 U	- -	0.02 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	10 U	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	0.87 U	0.5 U	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	10 U	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-14							
					Sample ID	800-MW-14-052400	800-MW-14-20001025	800-MW-14-20010619	800-MW-14-20020614	800-MW-14-20040621	800-MW-14-FBL	800-MW-14-F01R1	L800-MW14-F01R2
					Sample Depth (ft)	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35	25 - 35
					Sample Date	5/24/2000	10/25/2000	6/19/2001	6/14/2002	6/21/2004	3/21/2007	12/3/2007	1/10/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**390000**	**420000**	**400000**	**370000**	**378000**	**410000**	**393000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	**70**	**40**	**10**	40 U	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**55000**	**110000**	**180000**	**260000**	**412000**	**513000**	**426000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	**4100**	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	1200 U	300 U	300 U	1000 U	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	1000 U	1000 U	1000 U	1000 U	**5100**	500 U	**55100**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	**1800**	**1000**	**1000**	**2000**	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	***35200***	***33900***	***34100***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	***16000***	***11000***	***13000***	***26000***	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	50 U	***3400***	***2900***
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	**9900**	**10000**	**11000**	**10000**	**15800**	**12400**	**12700**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.16 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	**1.4 J**	**0.86 J**	**0.56 J**	**0.44 J**	**0.56**	**0.53**	**0.31**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.16 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.16 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.31 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.31 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.31 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.31 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.31 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.78 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	**0.5**	**0.33**	**0.43**
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	**0.24**	**0.24**	**0.21**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**1.8 J**	**0.37 J**	0.79 U	0.43 U	0.49 U	**0.3**	**0.21**	**0.28**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.16 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***9 J***	***9.4 J***	***4.5***	***5.9***	***4.4***	***7.5***	***6.4***	***5.6***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.31 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	**3 J**	- -	10 U	- -	20 U	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**180**	- -	**184 J**	- -	**223**	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.4 U	- -	5 U	- -	5 U	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**106000**	**105000**	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**4.3 J**	- -	10 U	- -	10 U	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	15 U	54.9 B	15 U
METALS	7439-92-1	Lead	µg/L	15	18.05	**2.5 J**	- -	**3.3 J**	- -	10 U	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**35300**	**37000**	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	3.1 B	6.4 B	2.6 B
METALS	7439-97-6	Mercury	µg/L	2	1	0.1 U	- -	0.21 U	- -	0.2 U	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.6 U	- -	10 U	- -	10 U	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	2.8 U	- -	10 U	- -	10 U	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**15400**	**15700**	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.16 U	0.46 U	0.79 U	0.43 U	0.49 U	0.19 U	0.21 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	**5**	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	10 U	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	0.5 U	0.5 U	0.5 U
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	10 U	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	3 U	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-14				800-MW-15			
					Sample ID	800-MW14-F01R3	L800-MW14-F01R4	L800-MW14-F01R5	L800-MW14-0818	800MW15-010600	800-MW-15-051600	D009-051600	800-MW-15-20001121
					Sample Depth (ft)	25 - 35	25 - 35	25 - 35	25 - 35	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	2/14/2008	3/12/2008	5/21/2008	8/20/2018	1/6/2000	5/16/2000	5/16/2000	11/21/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**400000**	**420000**	**495000**	- -	**260000**	- -	- -	**240000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	100 U	- -	- -	10 U
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**448000**	**468000**	**839000**	- -	**270000**	- -	- -	**34000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	**90**	- -	- -	1000 U
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	200 U	- -	- -	**3800**
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	100 U	- -	- -	300 U
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**56000**	**67600**	530 B	- -	620 U	- -	- -	1000 U
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	**11700**	- -	- -	**12000**
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	***29300***	***26600***	***27200***	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	**5900**	- -	- -	***11000***
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	50 U	50 U	50 U	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**16300**	**16300**	**15900**	- -	**27200**	- -	- -	**31000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	0.2 U	0.19 U	**0.053 J**	0.03 U	0.16 U	0.17 U	0.99 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	0.1 U	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**0.47**	**0.42**	**0.37**	0.1 U	- -	- -	- -	0.99 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.2 U	0.2 U	0.19 U	0.1 U	0.04 U	0.16 U	0.17 U	0.99 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.2 U	0.2 U	0.19 U	0.1 U	0.05 U	0.16 U	0.17 U	0.99 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.2 U	0.2 U	0.19 U	0.1 U	0.05 U	0.31 U	0.34 U	0.99 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.2 U	0.2 U	0.19 U	0.1 U	0.03 U	0.31 U	0.34 U	0.99 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	0.2 U	0.19 U	0.21 U	0.06 U	0.31 U	0.34 U	0.99 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	0.2 U	0.19 U	0.21 U	0.32 U	0.31 U	0.34 U	0.99 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.2 U	0.2 U	0.19 U	0.1 U	0.02 U	0.31 U	0.34 U	0.99 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	0.2 U	0.19 U	0.21 U	0.06 U	0.78 U	0.86 U	0.99 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**1**	**0.22**	**0.18 J**	**0.16 J**	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.2 U	**0.2**	**0.12 J**	**0.1 J**	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**0.28**	**0.95**	**0.18 J**	**0.17 J**	0.06 U	0.39 U	0.43 U	0.99 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	0.2 U	0.19 U	0.1 U	0.06 U	0.16 U	0.17 U	0.99 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***19.6***	5.3 B	***5.3***	***2.8***	0.05 U	0.16 U	0.17 U	0.93 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	0.2 U	0.19 U	0.1 U	0.03 U	0.31 U	0.34 U	0.99 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	2.7 U	**4.5 J**	**4.1 J**	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	**144**	**231**	**224**	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	0.64 U	0.3 U	0.3 U	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	**69700**	- -	- -	**74700**
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	9.7 U	**20.4**	**18.5**	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	15 U	15.5 B	15 U	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	3.4 U	**8.5**	**9.5**	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	**33000**	- -	- -	**34100**
METALS	7439-96-5	Manganese	μg/L	430	579.7	2.5 B	3.7 B	7.1 B	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	0.09 U	0.1 U	0.1 U	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	2.9 U	**3.4 J**	**4.5 J**	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	2.6 U	0.5 U	0.5 U	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	**7600**	- -	- -	**6400**
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.2 U	0.2 U	0.19 U	- -	0.02 U	0.16 U	0.17 U	0.99 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	0.5 U	**0.19 J**	0.5 U	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-15				800-MW-16			
					Sample ID	800-MW-15-20010618	800-MW-15-20020630	800-MW-15-20040608	L800-MW15-0818	800MW16-010600	800MWI6-010600	800-MW-16-052400	800-MW-16-20001121
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	60.5 - 70.5	60.5 - 70.5	60.5 - 70.5	60.5 - 70.5
					Sample Date	6/18/2001	6/30/2002	6/8/2004	8/19/2018	1/6/2000	1/6/2000	5/24/2000	11/21/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**210000**	**190000**	**230000**	- -	- -	**416000**	- -	**380000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	10 U	40 U	- -	- -	**290**	- -	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**320000**	**84000**	**75000**	- -	- -	**383000**	- -	**52000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	- -	- -	**290**	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	- -	- -	200 U	- -	**2300**
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	1000 U	- -	- -	**290**	- -	1200 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	**1300**	1000 U	- -	- -	620 U	- -	**1300**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**5000**	**5000**	**9000**	- -	- -	**9300**	- -	**5700**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**4400**	**4500**	**7800**	- -	- -	50 U	- -	**50**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**25000**	**29000**	**30000 J**	- -	- -	**34300**	- -	**34000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.6 U	0.68 U	0.48 U	0.1 U	0.03 U	- -	0.16 U	0.65 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	0.1 U	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.9 U	0.68 U	0.48 U	0.1 U	- -	- -	- -	0.65 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.6 U	0.68 U	0.48 U	0.1 U	6.6 U	- -	0.16 U	**0.87**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.6 U	0.68 U	0.48 U	0.1 U	0.05 U	- -	0.16 U	0.65 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.6 U	0.68 U	0.48 U	0.1 U	0.05 U	- -	0.31 U	0.65 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.6 U	0.68 U	0.48 U	0.1 U	2.5 U	- -	0.31 U	**0.19 J**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	1.6 U	0.68 U	1.6 U	0.2 U	0.06 U	- -	0.31 U	0.65 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	1.6 U	0.68 U	0.48 U	0.2 U	3.1 U	- -	0.31 U	0.65 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.6 U	0.68 U	0.48 U	0.1 U	**0.74**	- -	0.31 U	0.65 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	1.6 U	0.68 U	0.48 U	0.2 U	3.3 U	- -	0.78 U	0.65 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	0.2 U	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	0.1 U	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.6 U	0.68 U	0.48 U	0.1 U	0.06 U	- -	0.39 U	0.65 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	1.6 U	0.68 U	0.48 U	0.1 U	0.06 U	- -	0.16 U	0.65 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.6 U	0.68 U	0.48 U	0.1 U	0.08 U	- -	**1 J**	0.61 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.6 U	0.68 U	0.48 U	0.1 U	5.4 U	- -	0.31 U	0.65 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	- -	- -	- -	- -	***89***	**2.5**	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**97 J**	- -	- -	- -	- -	**236**	**201**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	- -	- -	- -	- -	0.64 U	0.4 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**53900**	- -	- -	- -	- -	**146000**	- -	**93900**
METALS	7440-47-3	Chromium	µg/L	100	31	**1.3 J**	- -	- -	- -	- -	**72.2**	**19.3**	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**3.9 J**	- -	- -	- -	- -	***23.5***	**2.6**	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**24600**	- -	- -	- -	- -	**56000**	- -	**38900**
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	- -	- -	- -	- -	0.13 U	0.1 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	- -	- -	- -	- -	**19.8**	2.6 U	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	- -	- -	- -	- -	3.9 U	2.8 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**5310**	- -	- -	- -	- -	**33400**	- -	**27100**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	1.6 U	0.68 U	0.48 U	- -	0.02 U	- -	0.16 U	0.65 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	10 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	10 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
					Location	800-MW-16			800-MW-17			
					Sample ID	800-MW-16-20010614	800-MW-16-20020630	800-MW-16-20040618	800MW17-010500	800-MW-17-052400	800-MW-17-20001120	800-MW-17-20010613
					Sample Depth (ft)	60.5 - 70.5	60.5 - 70.5	60.5 - 70.5	24.5 - 34.5	24.5 - 34.5	24.5 - 34.5	24.5 - 34.5
					Sample Date	6/14/2001	6/30/2002	6/18/2004	1/5/2000	5/24/2000	11/20/2000	6/13/2001
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**570000**	**400000**	**400000**	**386000**	- -	**400000**	**370000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	10 U	**20**	40 U	**440**	- -	**410**	**490**
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**140000**	**180000**	**140000**	**374000**	- -	**68000**	**320000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	1000 U	1000 U	1000 U	**380**	- -	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	μg/L	--	--	1000 U	1000 U	1000 U	200 U	- -	**3700**	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	**500**	**400**	**1000**	100 U	- -	**900**	**900**
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	1000 U	**1800**	1000 U	620 U	- -	**1400**	1000 U
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	**7000**	**6000**	**4000**	**2800**	- -	**3000**	**3000**
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	**40**	**40**	50 U	50 U	- -	**20**	**20**
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**47000**	**40000**	**34000**	**11000**	- -	**11000**	**11000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.94 U	0.64 U	0.48 U	0.03 U	0.16 U	1.1 U	0.66 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	1.2 U	0.64 U	0.48 U	- -	- -	1.1 U	0.83 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.94 U	0.64 U	0.48 U	**0.73**	**0.63 J**	**0.43 J**	0.66 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.94 U	0.64 U	0.48 U	0.05 U	0.16 U	1.1 U	0.66 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.94 U	0.64 U	0.48 U	0.05 U	0.31 U	1.1 U	0.66 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.94 U	0.64 U	0.48 U	**0.52**	**0.31 J**	1.1 U	0.66 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.94 U	0.64 U	1 U	0.06 U	0.31 U	1.1 U	0.66 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.94 U	0.64 U	0.48 U	0.22 U	0.31 U	1.1 U	0.66 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.94 U	0.64 U	0.48 U	**0.65**	**0.31 J**	1.1 U	0.66 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.94 U	0.64 U	0.48 U	0.06 U	0.78 U	1.1 U	0.66 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.94 U	0.64 U	0.48 U	0.06 U	0.39 U	1.1 U	0.66 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.94 U	0.64 U	0.48 U	0.06 U	0.16 U	1.1 U	0.66 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.94 U	0.64 U	0.48 U	0.05 U	0.16 U	1.1 U	0.66 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.94 U	0.64 U	0.48 U	0.03 U	0.31 U	1.1 U	0.66 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	10 U	- -	20 U	**4.5**	**5.4 J**	- -	10 U
METALS	7440-39-3	Barium	μg/L	2000	430	**1270**	- -	**126 J**	**165**	**208**	- -	**190 J**
METALS	7440-43-9	Cadmium	μg/L	5	5	5 U	- -	5 U	0.64 U	**0.4 J**	- -	5 U
METALS	7440-70-2	Calcium	μg/L	--	119033	**91800**	- -	- -	**93200**	- -	**88300**	**88700**
METALS	7440-47-3	Chromium	μg/L	100	31	**1.8 J**	- -	10 U	5.5 U	**36.7**	- -	10 U
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	**4.3 J**	- -	10 U	3.7 U	**2.6 J**	- -	**5.5 J**
METALS	7439-95-4	Magnesium	μg/L	--	45243	**39400**	- -	- -	**31200**	- -	**28000**	**29000**
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	0.21 U	- -	0.2 U	0.09 U	0.1 U	- -	0.21 U
METALS	7782-49-2	Selenium	μg/L	50	10	**4.6 J**	- -	10 U	2.9 U	2.6 U	- -	**3.2 J**
METALS	7440-22-4	Silver	μg/L	130	10	10 U	- -	10 U	1.1 U	2.8 U	- -	10 U
METALS	7440-23-5	Sodium	μg/L	--	42581	**30400**	- -	- -	**17800**	- -	**14200**	**15000**
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.94 U	0.64 U	0.48 U	0.02 U	0.16 U	1.1 U	0.66 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	**2 J**	- -	- -	- -	- -	- -	**130**
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	10 U	- -	- -	- -	- -	- -	10 U
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	10 U	- -	- -	- -	- -	- -	10 U
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	3 U	- -	- -	- -	- -	- -	3 U

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-17		800-MW-18					
					Sample ID	800-MW-17-20020629	800-MW-17-20040619	800MW18-010600	800-MW-18-050400	800-MW-18-20001127	800-MW-18-20010617	800-MW-18-20020628	800-MW-18-20020629
					Sample Depth (ft)	24.5 - 34.5	24.5 - 34.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	6/29/2002	6/19/2004	1/6/2000	5/4/2000	11/27/2000	6/17/2001	6/28/2002	6/29/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**370000**	**350000**	**204000**	- -	**250000**	**200000**	**280000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	**560**	**540**	100 U	- -	10 U	10 U	10 U	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**160000**	**180000**	**233000**	- -	**90000**	**160000**	**120000**	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	***28***
GENERAL	14265-44-2	Phosphate	μg/L	--	--	1000 U	1000 U	**380**	- -	1000 U	1000 U	1000 U	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	1000 U	1000 U	200 U	- -	**4100**	1000 U	1000 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	**1000**	**1000**	100 U	- -	**300**	300 U	300 U	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**1500**	1000 U	620 U	- -	1000 U	1000 U	**1500**	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	**4000**	**3000**	**18600**	- -	**18000**	**20000**	**6000**	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	**20**	50 U	**2400**	- -	**700**	**2000**	**890**	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**12000**	**11000**	**23300**	- -	**23000**	**29000**	**36000**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.73 U	0.49 U	0.03 U	0.16 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.73 U	0.49 U	- -	- -	1.2 U	0.39 U	0.23 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	**1.8 J**	0.49 U	0.04 U	0.16 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.73 U	0.49 U	0.05 U	0.16 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.73 U	0.49 U	0.05 U	0.31 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.73 U	0.49 U	0.03 U	0.31 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.73 U	0.76 U	0.06 U	0.31 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.73 U	0.49 U	0.18 U	0.31 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.73 U	0.49 U	0.03 U	0.31 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.73 U	0.49 U	0.06 U	0.78 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.73 U	0.49 U	0.06 U	0.39 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.73 U	0.49 U	0.06 U	0.16 U	1.2 U	0.31 U	0.23 U	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.73 U	0.49 U	0.05 U	0.16 U	1.1 U	0.31 U	**0.38**	- -
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.73 U	0.49 U	0.03 U	0.31 U	1.2 U	0.31 U	0.23 U	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	**6.4**	2.4 U	- -	10 U	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	**184**	**171**	- -	**126 J**	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	0.64 U	0.4 U	- -	5 U	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	**70400**	- -	**79000**	**63400**	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	10.6 U	**42.4**	- -	10 U	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	6.3 U	**4.5 J**	- -	10 U	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	**20800**	- -	**21000**	**19700**	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	0.14 U	0.1 U	- -	0.21 U	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	2.9 U	2.6 U	- -	**4.7 J**	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	1.1 U	2.8 U	- -	10 U	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	**17000**	- -	**15200**	**14800**	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.73 U	0.49 U	0.02 U	0.16 U	1.2 U	0.31 U	0.23 U	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	4 U	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	3 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-18							
					Sample ID	800-MW-18-20040620	F04-GW-005	F06-L800-MW18-GW-REG	800-MW-18-FBL	800-MW18-F01R1	800-MW18-F01R3	800-MW-18-F01R4	800-MW-18-F01R4-FD
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	6/20/2004	11/10/2004	9/13/2006	3/20/2007	12/4/2007	2/15/2008	3/12/2008	3/12/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**180000**	**160000**	- -	**570000**	**285000**	**190000**	**230000**	**233000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	40 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**130000**	**5000**	- -	**2390000**	**333000**	**248000**	**403000**	**352000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	2 U	4 U	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	1000 U	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	1000 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	1000 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	1000 U	1000 U	- -	**387000**	500 U	**47600**	**38400**	**40400**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	**610**	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	**17000**	**17000**	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	200 U	- -	50 U	85 B	**120**	**120**	**120**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	**280**	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	100 U	- -	***5500***	***2600***	50 U	50 U	50 U
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**35000**	**30000**	- -	**10500**	**38100**	**34200**	**39300**	**40300**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	1.3 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	0.48 U	- -	**133**	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	**0.22**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	**1.5**
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	20 U	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	121 B	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	1.1 B	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	**47000**	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	0.52 B	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	100 U	- -	***15800***	15 U	15 U	24.4 B	15 U
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	2.8 B	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	**13800**	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	**66.8**	- -	***2070***	**74.1**	7 B	10.2 B	9.8 B
METALS	7439-97-6	Mercury	μg/L	2	1	- -	0.2 U	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	2.5 B	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	**14700 E**	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	16.6 B	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.49 U	0.48 U	- -	0.19 U	0.19 U	0.2 U	0.19 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	**0.78 J**	- -	**9390**	**0.58**	**0.33 J**	**0.23 J**	**0.29 J**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-18		800-MW-19					
					Sample ID	L800-MW18-F01R5	L800-MW18-0818	800MW19-010700	800-MW-19-052000	800-MW-19-20001122	800-MW-19-20010616	800-MW-19-20020618	800-MW-19-20040619
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	64 - 74	64 - 74	64 - 74	64 - 74	64 - 74	64 - 74
					Sample Date	5/21/2008	8/18/2018	1/7/2000	5/20/2000	11/22/2000	6/16/2001	6/18/2002	6/19/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**245000**	- -	**427000**	- -	**432000**	**440000**	**440000**	**420000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	590 U	- -	**290**	**270**	**320**	**850**
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**378000**	- -	**410000**	- -	**65000**	**240000**	**190000**	**60000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	220 U	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	200 U	- -	**2200**	1000 U	**3000**	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	1500 U	- -	**600**	**400**	**500**	1000 U
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**1400**	- -	620 U	- -	**1900**	**1100**	**1200**	**1200**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	**2900**	- -	1000 U	**1000**	1000 U	1000 U
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	**110**	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	50 U	- -	10 U	**60**	10 U	50 U
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	50 U	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**40900**	- -	**5400**	- -	**4400**	**2000**	1000 U	**2000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.19 U	0.1 U	0.03 U	0.16 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	0.1 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.19 U	0.1 U	- -	- -	0.87 U	0.71 U	1.1 U	0.49 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.19 U	0.1 U	0.04 U	0.16 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.19 U	0.1 U	0.05 U	0.16 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.19 U	0.1 U	0.05 U	0.31 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.19 U	0.1 U	0.03 U	0.31 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.19 U	0.21 U	0.06 U	0.31 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.19 U	0.21 U	0.06 U	0.31 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.19 U	0.1 U	0.14 U	0.31 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.19 U	0.21 U	0.06 U	0.78 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.19 U	0.21 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.19 U	0.1 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.19 U	0.1 U	0.08 U	**0.4**	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.19 U	0.1 U	0.06 U	0.16 U	0.87 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.19 U	**0.059 J**	0.95 U	0.16 U	0.82 U	0.57 U	0.86 U	0.49 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.19 U	0.1 U	1.8 U	0.31 U	0.87 U	0.57 U	0.86 U	0.49 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	2.7 U	**2.5 J**	- -	10 U	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	**251**	**224**	- -	**242**	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	0.64 U	0.4 U	- -	**1.8 J**	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	**108000**	- -	**94000**	**92600**	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	**28.5**	**5 J**	- -	10 U	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	15 U	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	**1.6**	1.7 U	- -	10 U	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	**42800**	- -	**37500**	**41500**	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	4.9 B	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	0.06 U	0.1 U	- -	0.21 U	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	2.9 U	2.6 U	- -	**2 J**	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	1.1 U	2.8 U	- -	10 U	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	**25700**	- -	**18000**	**19800**	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.19 U	- -	0.02 U	0.16 U	0.87 U	0.57 U	0.86 U	0.49 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	6 U	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**0.29 J**	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	3 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-2								
					Sample ID	800MW02-011200	800-MW-2-052400	800-MW-2-20001122	800-MW-2-20010613	800-MW-2-20020630	800-MW-2-20040621	800MW-2	800-MW2-150605	MW-02-01R2
					Sample Depth (ft)	66 - 76	66 - 76	66 - 76	66 - 76	66 - 76	66 - 76	66 - 76	66 - 76	66 - 76
					Sample Date	1/12/2000	5/24/2000	11/22/2000	6/13/2001	6/30/2002	6/21/2004	5/19/2005	6/15/2005	7/13/2005
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**447000**	- -	**420000**	**460000**	**440000**	**420000**	**440000**	**430000**	**430000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	440 U	- -	**260**	**170**	**220**	**220**	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**409000**	- -	**82000**	**240000**	**190000**	**700000**	**1800000**	**140000**	- -
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	260 U	- -	- -	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	**610**	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	- -	**400**	300 U	**400**	1000 U	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	**1400**	1000 U	**1500**	1000 U	**1200**	**1300**	**1000**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**1800**	- -	- -	**1000**	**1000**	1000 U	- -	**2000**	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	**400**	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	**300**	**200**	200 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	**160**	**200**	**150**	**80**	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	100 U	100 U	100 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**27500**	- -	- -	**25000**	**26000**	**26000**	**24000**	**24000**	**23000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.9 U	1 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.12 U	0.31 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.02 U	0.31 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.06 U	0.78 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.48 U	0.54 U	0.49 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.54 U	0.49 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.05 U	0.16 U	0.84 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.03 U	0.31 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	2.4 U	- -	10 U	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**189**	**199**	- -	**143 J**	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	- -	5 U	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**107000**	- -	**96200**	**92200**	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**9.4**	**22.3**	- -	**0.4 J**	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	100 UN	45.3 B	100 U
METALS	7439-92-1	Lead	µg/L	15	18.05	**2.3**	**4.3 J**	- -	**4.7 J**	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**44500**	- -	**39700**	**40200**	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	**162**	**154**	**118**
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	- -	0.21 U	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	- -	**3.1 J**	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	- -	10 U	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**27100**	- -	**23900**	**25700**	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.9 U	0.82 U	0.75 U	0.49 U	0.48 U	0.54 U	0.49 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	0.11 U	- -	3 U	3 U	3 U	- -	1 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	3 U	3 U	3 U	- -	**4.3**	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	0.31 U	- -	3 U	3 U	3 U	- -	1 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	0.61 U	- -	3 U	3 U	3 U	- -	1 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	0.51 U	- -	3 U	3 U	3 U	- -	1 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	0.14 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	**5.3 J**	- -	10 U	10 U	10 U	- -	5 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	0.51 U	- -	3 U	3 U	3 U	- -	1 U	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.87 U	0.87 U	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	**2.3 J**	- -	10 U	10 U	10 U	- -	5 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	0.82 U	- -	3 U	3 U	3 U	- -	1 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	0.3 U	- -	3 U	3 U	3 U	- -	1 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	0.61 U	- -	3 U	3 U	3 U	- -	1 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-2				800-MW-20				
					Sample ID	MW02-01R3	MW-02-01R4	MW-02-02R1	MW-02-02R2	800MW20-010900	800-MW-20-052400	800-MW-20-20001130	800-MW-20-20010616	800-MW-20-20020630
					Sample Depth (ft)	66 - 76	66 - 76	66 - 76	66 - 76	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	8/25/2005	11/8/2005	1/30/2006	4/6/2006	1/9/2000	5/24/2000	11/30/2000	6/16/2001	6/30/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**439000**	**350000**	**400000**	**408000**	**298000**	- -	**230000**	**230000**	**190000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	**150**	- -	**10**	**20**	**30**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**423000**	**3980000**	**539000**	**479000**	**268000**	- -	**58000**	**170000**	**84000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	**220**	- -	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	200 U	- -	1000 U	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	100 U	- -	**400**	300 U	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1700**	760 B	**1300**	**1800**	620 U	- -	**1100**	1000 U	**1600**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	**2400**	- -	**2600**	**2000**	**2000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	90 B	50 U	50 U	**320**	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	50 U	- -	**840**	**1400**	**1400**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	50 U	50 U	50 U	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**21800**	**24600**	**25500**	**24900**	**24300**	- -	**34000**	**33000**	**35000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.21 U	0.19 U	0.19 U	0.03 U	0.16 U	0.61 U	0.58 U	1 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	0.21 U	0.19 U	0.19 U	- -	- -	0.61 U	0.73 U	1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.21 U	0.19 U	0.19 U	0.04 U	0.16 U	0.61 U	0.58 U	1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.21 U	0.19 U	0.19 U	0.05 U	0.16 U	0.61 U	0.58 U	1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.21 U	0.19 U	0.19 U	0.05 U	0.31 U	0.61 U	0.58 U	1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.21 U	0.19 U	0.19 U	0.03 U	0.31 U	0.61 U	0.58 U	1 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.21 U	0.19 U	0.19 U	0.06 U	0.31 U	0.61 U	0.58 U	1 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.19 U	0.21 U	0.19 U	0.19 U	0.11 U	0.31 U	0.61 U	0.58 U	1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.21 U	0.19 U	0.19 U	0.02 U	0.31 U	0.61 U	0.58 U	1 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.21 U	0.19 U	0.19 U	0.06 U	0.78 U	0.61 U	0.58 U	1 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	0.21 U	0.19 U	0.19 U	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	0.21 U	0.19 U	0.19 U	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**0.25**	0.21 U	0.19 U	0.19 U	0.06 U	0.39 U	0.61 U	0.58 U	1 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.21 U	0.19 U	0.19 U	0.06 U	0.16 U	0.61 U	0.58 U	1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	**1.6**	**0.45**	**0.16 J**	**0.47**	0.23 U	0.16 U	0.57 U	0.58 U	1 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.21 U	0.19 U	0.19 U	2.6 U	0.31 U	0.61 U	0.58 U	1 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	**8.9**	**16.9**	- -	10 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	**164**	**309**	- -	**100 J**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	0.64 U	**1.6 J**	- -	5 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	**85600**	- -	**60600**	**41000**	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	**28.3**	**44.4**	- -	10 U	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	7.5 U	7.5 U	101 B	22.6 B	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	**5.2**	***19.1***	- -	10 U	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	**30100**	- -	**19800**	**15800**	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	**242**	**209**	***874***	**126**	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	0.06 U	0.1 U	- -	0.21 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	2.9 U	2.6 U	- -	**5.2 J**	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	1.1 U	2.8 U	- -	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	**20000**	- -	**10600**	**8060**	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.21 U	0.19 U	0.19 U	**0.02**	0.16 U	0.61 U	0.58 U	1 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	0.5 U	- -	3 U	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	6 U	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	0.5 U	- -	3 U	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	0.5 U	- -	3 U	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	0.5 U	- -	3 U	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	2 U	- -	10 U	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	0.5 U	- -	3 U	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	2 U	- -	10 U	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	0.5 U	- -	3 U	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	0.5 U	- -	3 U	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	0.5 U	- -	3 U	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	800-MW-20				800-MW-21			
					Sample ID	800-MW-20-20040621	F04-GW-007	800-MW-20-FBL	L800-MW20-0818	800MW21-011100	800-MW-21-051800	800-MW-21-20010612	800-MW-21-20020628
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	67 - 77	67 - 77	67 - 77	67 - 77
					Sample Date	6/21/2004	11/11/2004	3/21/2007	8/28/2018	1/11/2000	5/18/2000	6/12/2001	6/28/2002
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**200000**	**200000**	**238000**	- -	**425000**	- -	**452000**	**460000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	40 U	- -	- -	- -	**440**	- -	**210**	**240**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**34000**	**6500**	**288000**	- -	**388000**	- -	**280000**	**200000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	- -	- -	**280**	- -	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	- -	- -	- -	200 U	- -	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	1000 U	- -	- -	- -	100 U	- -	**400**	**400**
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000 U	**3000**	- -	620 U	- -	**1200**	**1400**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2000**	**2000**	- -	- -	**3000**	- -	**2000**	**2000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	**1100**	**280**	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**810**	- -	- -	- -	50 U	- -	**60**	**80**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	100 U	50 U	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**33000**	**32000**	**32700**	- -	**27400**	- -	**30000**	**30000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.49 U	0.49 U	0.19 U	0.1 U	0.03 U	0.16 U	0.51 U	1.4 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	0.1 U	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.49 U	0.49 U	0.19 U	0.1 U	- -	- -	0.63 U	1.4 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.49 U	0.49 U	0.19 U	0.1 U	0.04 U	0.16 U	0.51 U	1.4 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.49 U	0.49 U	0.19 U	0.1 U	0.3 U	0.16 U	0.51 U	1.4 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.49 U	0.49 U	0.19 U	0.1 U	0.05 U	0.31 U	0.51 U	1.4 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.49 U	0.49 U	0.19 U	0.1 U	0.26 U	0.31 U	0.51 U	1.4 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.61 U	0.49 U	0.19 U	0.2 U	0.06 U	0.31 U	0.51 U	1.4 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.49 U	0.49 U	0.19 U	0.2 U	0.62 U	0.31 U	0.51 U	1.4 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.49 U	0.49 U	0.19 U	0.1 U	0.21 U	0.31 U	0.51 U	1.4 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.49 U	0.49 U	0.19 U	0.2 U	0.06 U	0.78 U	0.51 U	1.4 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	0.49 U	0.19 U	0.2 U	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.49 U	0.19 U	0.1 U	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.49 U	0.49 U	0.19 U	0.1 U	0.36 U	0.39 U	0.51 U	1.4 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.49 U	0.49 U	0.19 U	0.1 U	0.35 U	0.16 U	0.51 U	1.4 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.49 U	0.49 U	0.19 U	0.1 U	0.22 U	0.16 U	0.51 U	1.4 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.49 U	0.49 U	0.19 U	0.1 U	0.07 U	0.31 U	0.51 U	1.4 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	20 U	3.5 B	- -	- -	***68.9***	4.5 U	10 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**109 J**	108 B	- -	- -	**585**	**130**	**158 J**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	0.68 B	- -	- -	0.64 U	0.4 U	5 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	**49600**	- -	- -	**108000**	- -	**97300**	- -
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	0.75 B	- -	- -	***110***	**4.1 J**	**1.7 J**	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	**166**	15 U	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	2.4 B	- -	- -	**14.2**	2.9 U	**5.1 J**	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	**16700**	- -	- -	**40700**	- -	**48800**	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	**127**	**70**	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.2 U	0.2 U	- -	- -	0.06 U	0.1 U	0.21 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	4 B	- -	- -	**4.2**	2.6 U	10 U	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	- -	- -	1.1 U	2.8 U	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	**9700 E**	- -	- -	**36400**	- -	**17300**	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	13.8 B	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.49 U	0.49 U	0.19 U	- -	0.28 U	0.16 U	0.51 U	1.4 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	10 U	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	0.87 U	0.5 U	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	10 U	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	3 U	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-21	800-MW-22					
					Sample ID	800-MW-21-20040619	800MW22-011100	800-MW-22-051900	800-MW-22-20001023	800-MW-22-20010615	800-MW-22-20020614	800-MW-22-20040615
					Sample Depth (ft)	67 - 77	54 - 64	54 - 64	54 - 64	54 - 64	54 - 64	54 - 64
					Sample Date	6/19/2004	1/11/2000	5/19/2000	10/23/2000	6/15/2001	6/14/2002	6/15/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**430000**	**485000**	- -	**450000**	**460000**	**450000**	**440000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	**120**	150 U	- -	**140**	**110**	**140**	**190**
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**70000**	**444000**	- -	**65000**	**280000**	**200000**	**170000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	1000 U	10 U	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	μg/L	--	--	1000 U	**1800**	- -	**5100**	1000 U	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	1000 U	100 U	- -	**500**	**400**	**400**	1000 U
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**1100**	620 U	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	**1000**	**5400**	- -	**2500**	**2000**	**1000**	**2000**
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	**110**	50 U	- -	10 U	**40**	10 U	50 U
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**32000**	**37900**	- -	**28000**	**29000**	**32000**	**31000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.48 U	0.03 U	0.16 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.48 U	- -	- -	0.87 U	1.9 U	0.42 U	0.48 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.48 U	0.04 U	0.16 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.48 U	0.05 U	0.16 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.48 U	0.05 U	0.31 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.48 U	0.03 U	0.31 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.57 U	0.06 U	0.31 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.48 U	0.12 U	0.31 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.48 U	0.02 U	0.31 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.48 U	0.06 U	0.78 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.48 U	0.06 U	0.39 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.48 U	**0.06**	0.16 U	0.87 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.48 U	0.07 U	0.16 U	0.82 U	1.6 U	0.34 U	0.48 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.48 U	0.03 U	0.31 U	0.87 U	1.6 U	0.34 U	0.48 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	20 U	***64.3***	**4.6 J**	- -	**4.3 J**	- -	**4.7 J**
METALS	7440-39-3	Barium	μg/L	2000	430	**148 J**	**502**	**215**	- -	**1540**	- -	**134 J**
METALS	7440-43-9	Cadmium	μg/L	5	5	5 U	**4.5**	0.3 U	- -	5 U	- -	5 U
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	**447400**	- -	**117000**	**116000**	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	10 U	***174***	**19.6**	- -	**6 J**	- -	**8.6 J**
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	10 U	***97.1***	***24.3***	- -	10 U	- -	10 U
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	**171000**	- -	**48700**	**47800**	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	0.2 U	0.06 U	0.1 U	- -	0.21 U	- -	0.2 U
METALS	7782-49-2	Selenium	μg/L	50	10	10 U	**8.5**	**4.9 J**	- -	**2.7 J**	- -	10 U
METALS	7440-22-4	Silver	μg/L	130	10	10 U	1.1 U	0.5 U	- -	**0.4 J**	- -	10 U
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	**39000**	- -	**21200**	**24200**	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.48 U	0.02 U	0.16 U	0.87 U	1.6 U	0.34 U	0.48 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	**1 J**	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-23						800-MW-24	
					Sample ID	800MW23-010800	800-MW-23-052400	800-MW-23-20001128	800-MW-23-20010614	800-MW-23-20020626	800MW23	800MW24-010600	800-MW-24-051900
					Sample Depth (ft)	54 - 64	54 - 64	54 - 64	54 - 64	54 - 64	54 - 64	67 - 77	67 - 77
					Sample Date	1/8/2000	5/24/2000	11/28/2000	6/14/2001	6/26/2002	6/6/2004	1/6/2000	5/19/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**482000**	- -	**440000**	**450000**	**430000**	**420000**	**416000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	100 U	- -	**60**	**70**	**110**	**160**	**730**	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**476000**	- -	**150000**	**220000**	**190000**	**48000**	**398000**	- -
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	180 U	- -	1000 U	1000 U	1000 U	1000 U	**250**	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	1000 U	1000 U	1000 U	1000 U	200 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	- -	300 U	**300**	300 U	1000 U	**290**	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	**1600**	1000 U	1000 U	**1000**	620 U	- -
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2500**	- -	**4200**	**6000**	**11000**	**21000**	**2900**	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	20 U	- -	**30**	50 U	50 U	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**37700**	- -	**51000**	**38000**	**42000**	**48000**	**4500**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.39 U	0.86 U	1 U	0.49 U	0.03 U	0.16 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.39 U	1.1 U	1 U	0.49 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.39 U	0.86 U	1 U	0.49 U	1.1 U	0.16 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.39 U	0.86 U	1 U	0.49 U	0.05 U	0.16 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.39 U	0.86 U	1 U	0.49 U	0.05 U	0.31 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	0.39 U	0.86 U	1 U	0.49 U	0.32 U	0.31 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.39 U	0.86 U	1 U	2.1 U	0.06 U	0.31 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.06 U	0.31 U	0.39 U	0.86 U	1 U	0.49 U	0.35 U	0.31 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.02 U	0.31 U	0.39 U	0.86 U	1 U	0.49 U	0.19 U	0.31 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.06 U	0.78 U	0.39 U	0.86 U	1 U	0.49 U	0.06 U	0.78 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	0.39 U	0.86 U	1 U	0.49 U	0.18 U	0.39 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.39 U	0.86 U	1 U	0.49 U	0.06 U	0.16 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.37 U	0.16 U	0.37 U	0.86 U	1 U	0.49 U	0.05 U	0.16 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	2.2 U	0.31 U	0.39 U	0.86 U	1 U	0.49 U	1.5 U	0.31 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	**3.8**	**7.1 J**	- -	10 U	- -	- -	**2.9**	2.5 U
METALS	7440-39-3	Barium	µg/L	2000	430	**165**	**143**	- -	**123 J**	- -	- -	**135**	**162**
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	**0.4 J**	- -	5 U	- -	- -	0.64 U	0.3 U
METALS	7440-70-2	Calcium	µg/L	--	119033	**157000**	- -	**103000**	**101000**	- -	- -	**91200**	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**40.6**	**19.9**	- -	**0.6 J**	- -	- -	10.3 U	**78.5**
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**5.3**	**4.3 J**	- -	**4.1 J**	- -	- -	2.1 U	**4.8 J**
METALS	7439-95-4	Magnesium	µg/L	--	45243	**65600**	- -	**39900**	**40500**	- -	- -	**36400**	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	- -	0.21 U	- -	- -	0.09 U	0.1 U
METALS	7782-49-2	Selenium	µg/L	50	10	3.3 U	2.6 U	- -	**4 J**	- -	- -	2.9 U	2 U
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	- -	10 U	- -	- -	2.6 U	0.5 U
METALS	7440-23-5	Sodium	µg/L	--	42581	**20700**	- -	**23100**	**23900**	- -	- -	**18800**	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.39 U	0.86 U	1 U	0.49 U	0.02 U	0.16 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-24				800-MW-25			
					Sample ID	800-MW-24-20001129	800-MW-24-20010616	800-MW-24-20020628	800MW24	800MW25-011200	800-MW-25-050400	800-MW-25-20001127	800-MW-25-20010619
					Sample Depth (ft)	67 - 77	67 - 77	67 - 77	67 - 77	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	11/29/2000	6/16/2001	6/28/2002	6/7/2004	1/12/2000	5/4/2000	11/27/2000	6/19/2001
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**420000**	**420000**	**430000**	**410000**	**329000**	- -	**330000**	**360000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**460**	**480**	**480**	**500**	**5000**	- -	**20**	**10**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**110000**	**220000**	**190000**	**140000**	**315000**	- -	**95000**	**140000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	520 U	- -	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	**6200**	1000 U	1000 U	1000 U	**610**	- -	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**900**	**600**	**800**	**1100**	100 U	- -	**300**	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1800**	**1400**	**1900**	**1700**	620 U	- -	**2500**	**1900**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2400**	**2000**	**2000**	**2000**	**5700**	- -	**4800**	**5000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	20 U	**30**	10 U	50 U	**1200**	- -	**610**	**360**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**3100**	**2000**	**2000**	**2000**	**53200**	- -	**49000**	**44000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.64 U	0.4 U	0.99 U	0.49 U	0.03 U	0.16 U	0.42 U	0.64 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.64 U	0.5 U	0.99 U	0.49 U	- -	- -	**55**	**127**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.64 U	0.4 U	0.99 U	0.49 U	0.04 U	0.16 U	0.42 U	0.64 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.64 U	0.4 U	0.99 U	0.49 U	0.05 U	0.16 U	0.42 U	0.64 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.64 U	0.4 U	0.99 U	0.49 U	0.05 U	0.31 U	0.42 U	0.64 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.64 U	0.4 U	0.99 U	0.49 U	0.03 U	0.31 U	0.42 U	0.64 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.64 U	0.4 U	0.99 U	0.49 U	0.06 U	0.31 U	0.42 U	0.64 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.64 U	0.4 U	0.99 U	0.49 U	0.12 U	0.31 U	0.42 U	0.64 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.64 U	0.4 U	0.99 U	0.49 U	0.02 U	0.31 U	0.42 U	0.64 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.64 U	0.4 U	0.99 U	0.49 U	0.06 U	0.78 U	0.42 U	0.64 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.64 U	0.4 U	0.99 U	0.49 U	0.06 U	**120**	**20**	**14**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.64 U	0.4 U	0.99 U	0.49 U	0.2 U	0.16 U	0.42 U	0.64 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.6 U	0.4 U	0.99 U	0.49 U	***1400***	***1000***	***1400***	***1600***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.64 U	0.4 U	0.99 U	0.49 U	0.03 U	0.31 U	0.42 U	0.64 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	10 U	- -	- -	2.7 U	2.4 U	- -	**3.6 J**
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**153 J**	- -	- -	**102**	**128**	- -	**96.8 J**
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	5 U	- -	- -	0.64 U	0.4 U	- -	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	**98300**	**90300**	- -	- -	**91600**	- -	**85600**	**90800**
METALS	7440-47-3	Chromium	µg/L	100	31	- -	10 U	- -	- -	**1.8**	**19.1**	- -	**1.1 J**
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	10 U	- -	- -	1.4 U	**3.1 J**	- -	**5 J**
METALS	7439-95-4	Magnesium	µg/L	--	45243	**39100**	**38000**	- -	- -	**40500**	- -	**37600**	**39800**
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.21 U	- -	- -	**0.21**	0.1 U	- -	0.21 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	**3.8 J**	- -	- -	2.9 U	2.6 U	- -	10 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	10 U	- -	- -	1.1 U	2.8 U	- -	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	**16300**	**16800**	- -	- -	**11800**	- -	**10100**	**10300**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.64 U	0.4 U	0.99 U	0.49 U	0.02 U	0.16 U	0.42 U	0.64 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	8 U	- -	- -	- -	- -	- -	3 U
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	10 U	- -	- -	- -	- -	- -	10 U
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	10 U	- -	- -	- -	- -	- -	10 U
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	3 U	- -	- -	- -	- -	- -	3 U
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	3 U

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-25							
					Sample ID	800-MW-25-20020628	800-MW-25-20040621	F04-GW-024	800-MW-25-FBL	800MW-25-F01R1	L800-MW25-F01R2	L800-MW25-F01R3	800-MW-25-F01R4
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	6/28/2002	6/21/2004	11/12/2004	9/24/2007	12/18/2007	1/16/2008	2/22/2008	3/18/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95(1))**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**350000**	**290000**	**290000**	**275000**	**890000**	**304000**	**328000**	**430000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	40 U	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**150000**	**220000**	**5200**	**451000**	**934000**	**330000**	**420000**	**511000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**400**	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**2000**	**1800**	**2100**	**1800**	**40200**	500 U	**57400**	**64600**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**5000**	**3000**	**3000**	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	200 U	**110**	50 U	50 U	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**250**	**220**	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	100 U	50 U	***2600***	***2500***	50 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**43000**	**41000**	**36000**	**64700**	**60600**	**59200**	**54900**	**53500**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**50**	**27**	**46**	**34.3**	**16.4**	**23.5**	**16.7**	**23.4**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.87 U	0.49 U	0.52 U	**0.23**	**0.086 J**	**0.077 J**	0.98 U	0.2 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.87 U	6.3 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.87 U	0.49 U	0.52 U	**1.4**	**0.55**	**0.46**	**0.35 J**	**0.37**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	**59**	**32.7**	**23.4**	**30.4**	**23.3**	**29.6**
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	**24 P**	**15**	**7.8**	**11.2**	**7.3**	**11.1**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**26**	**120**	**33**	**43.5**	**18.4**	**25.2**	**19.5**	**21.9**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***1600 J***	***720***	***1400 D***	***1050***	***458***	***678***	***507***	***701***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	15 U	15 U	15 U	15 U	15 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	8.1 B	***4030***	***2880***	***2260***	***2580***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.87 U	0.49 U	0.52 U	0.19 U	0.19 U	0.19 U	0.98 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	0.87 U	- -	**7.2**	**3.72**	**2.9**	**8.14**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-25						
					Sample ID	800-MW-25-F01R4-FD	L800-MW25-F01R5	L800-MW-25-F01R6	800-MW-25-01R7	800-MW-25-F01R7	800-MW-25-F01R9	L800-MW25-0818
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	3/18/2008	5/27/2008	9/29/2008	3/9/2009	3/10/2009	8/28/2009	8/18/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95(1))**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**358000**	**335000**	**291000**	**404000**	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**431000**	**431000**	**293000**	**427000**	- -	- -	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**69100**	**1600**	**1600**	**1800**	- -	**2500**	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	50 U	50 U	50 U	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	50 U	50 U	50 U	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**53300**	**51000**	**51500**	**40600**	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	**1060000**	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	**1000000**	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	0 U	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	0 U	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.1 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**19.5**	**26.8**	**30.5**	**4.3**	- -	**16**	**6.9**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	***6.2 J***	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.1 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.21 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.21 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**0.35**	9.7 U	**0.51**	**0.22**	- -	7.7 U	0.1 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.21 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**20.3**	**27.1**	**30.5**	**17.5**	- -	**30.1**	**25 J**
EXPLOSIVES	DNX	DNX	μg/L	--	--	**8**	**10**	**11.5**	**2.4**	- -	**7.5 J**	**3.9**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**21.1**	**22.7**	**33.3**	**14.2**	- -	**21.6**	**13 J**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.1 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***629***	***720***	***935***	***122***	- -	***451***	***180 J***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	0.1 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	15 U	15 U	23 U	23 U	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***2660***	***2420***	***2060***	***4970***	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.2 U	9.7 U	0.19 U	0.19 U	- -	7.7 U	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**9.25**	**9.37**	**10.9**	**587**	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-26							
					Sample ID	800MW26-011100	800-MW-26-051100	800-MW-26-20001024	800-MW-26-20010615	800-MW-26-20020614	800-MW-26-20040615	F04-GW-016	800-MW-26-FBL
					Sample Depth (ft)	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17
					Sample Date	1/11/2000	5/11/2000	10/24/2000	6/15/2001	6/14/2002	6/15/2004	11/11/2004	3/19/2007
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**237000**	- -	**270000**	**240000**	**270000**	**200000**	**180000**	**114000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**1000**	- -	**70**	**50**	**30**	**110**	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**280000**	- -	**50000**	**170000**	**120000**	**600000**	**5700**	**160000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	**59000**	- -	1000 U	1000 U	1000 U	1000 U	1000 U	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	**1000**	- -	1000 U	1000 U	1000 U	1000 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**290**	- -	300 U	300 U	**300**	1000 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	**1700**	**1700**	**1500**	**2000**	**1900**	**3900**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**4300**	- -	**12000**	**2000**	**2000**	**1000**	**2000**	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	**1500**	***21500***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**9000**	- -	**5100**	**5400**	**2300**	**1300**	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	100 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**40800**	- -	**3900000**	**31000**	**34000**	**38000**	**40000**	**37500**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	**0.87**	0.84 U	0.61 U	0.27 U	0.49 U	0.5 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	**4.2 J**	**4.9 J**	**2.4**	**1.4 J**	**2**	**0.51**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***6.1***	***8.3***	**1.6 J**	0.61 U	0.27 U	**0.36 J**	**0.65**	**0.27**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	***1.2***	0.84 U	0.61 U	0.27 U	0.49 U	**0.22 J**	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***0.59***	***1.8***	0.84 U	***0.64***	***0.61 J***	0.49 U	***0.25 J***	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***7.6***	***7.9***	**0.94 J**	**1.3**	**0.63 J**	**1.5 J**	***2***	**0.66**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.84 U	0.61 U	0.27 U	0.49 U	0.5 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.06 U	0.31 U	0.84 U	0.61 U	0.27 U	0.49 U	0.5 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***8.1***	***13***	***2.3 J***	***2.9***	**1.9 J**	***2.7***	***3.3***	**1.2**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	**0.58**	**0.78**	0.84 U	0.61 U	0.27 U	0.49 U	0.5 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	**0.5 P**	**0.14 J**
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	**0.25 JP**	0.2 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**51**	**110**	**16 J**	**31**	**17 J**	**20**	**30**	**7**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	***4.3***	0.16 U	0.84 U	0.61 U	0.27 U	0.49 U	0.5 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***440***	***800***	***310 J***	***440***	***260***	***87***	***190 D***	***33.1***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.03 U	0.31 U	0.84 U	0.61 U	0.27 U	0.49 U	0.5 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	2.4 U	- -	10 U	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**121**	**181**	- -	**187 J**	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	- -	5 U	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**75600**	- -	**72800**	**65200**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**16.2**	**18**	- -	**0.6 J**	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	15 U
METALS	7439-92-1	Lead	µg/L	15	18.05	**2.5**	**7.4**	- -	10 U	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**29000**	- -	**26500**	**27000**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	**45.9**
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	- -	0.21 U	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	- -	**2.6 J**	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	2.8 U	- -	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**13100**	- -	**11800**	**10500**	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.16 U	**0.58**	0.84 U	0.61 U	0.27 U	0.49 U	0.5 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	**22**	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	**17**	**0.87**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-26							
					Sample ID	800-MW-26-F01R1	L800-MW26-F01R2	L800-MW26-F01R3	L800-MW26-F01R3-FD	800-MW-26-F01R4	800-MW26-F01R4	L800-MW26-F01R5	800-MW-26-F01R6
					Sample Depth (ft)	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17	7 - 17
					Sample Date	12/10/2007	1/15/2008	2/20/2008	2/20/2008	3/18/2008	3/27/2008	5/21/2008	9/30/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**285000**	**183000**	**235000**	**200000**	**190000**	**223000**	**285000**	**209000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**586000**	**222000**	**359000**	**363000**	**318000**	**340000**	**467000**	**280000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**3200**	**141000**	**50800**	**49000**	**47700**	- -	**1400**	**1200**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**340**	**220**	**220**	**190**	- -	**230**	**3000**	***11600***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	***3700***	***1600***	50 U	50 U	- -	90 B	50 U	**180**
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**20800**	**40800**	**28400**	**27800**	**33900**	**34800**	**38100**	**31500**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.2 U	**3.2**	**0.58**	**0.58**	**0.58**	- -	**3.3**	**3.7**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	***0.12 J***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	**0.12 J**	0.19 U	0.19 U	0.19 U	- -	0.19 U	**0.11 J**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.2 U	**0.52**	0.19 U	0.19 U	**0.24**	- -	**0.53**	**1.2**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**0.093 J**	**28.6**	**1**	**1.2**	**2.1**	- -	**0.53**	**0.51**
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.2 U	**3.1**	0.19 U	0.19 U	0.19 U	- -	**0.28**	**0.41**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**0.68**	**9.9**	**1.7**	**2**	**4.7**	- -	**14.1**	**21.4**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	**1.6**	***36.3***	***18.1***	***19***	***34.8***	- -	***174***	***260***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	**900**	**4320**	**4200**	**4360**	**2210**	- -	15 U	**306**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	***20700***	***4790***	***9610***	***9700***	***6400***	- -	***3010***	***1790***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.19 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**1.7**	**25.5**	**69.4**	**85.4**	**42.2**	- -	**32.9**	**17**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-26				800-MW27	800-MW28	800-MW29
					Sample ID	800-MW-26-01R7	800-MW-26-F01R7	800-MW-26-F01R9	L800-MW26-0818	L800-MW27-0818	L800-MW28-0818	L800-MW29-0818
					Sample Depth (ft)	7 - 17	7 - 17	7 - 17	7 - 17	10 - 20	10 - 20	10 - 20
					Sample Date	3/9/2009	3/10/2009	8/27/2009	8/19/2018	8/29/2018	8/27/2018	8/28/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**308000**	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**406000**	- -	- -	- -	- -	- -	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**8400**	- -	**2700**	- -	- -	- -	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	**1100**	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	50 U	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**15700**	- -	- -	- -	- -	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	**991000**	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	**645000**	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	**390000**	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	**19500**	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	**0.085 J**	- -	0.2 U	0.1 U	**1**	0.1 UJ	0.1 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	0.1 U	0.1 U	0.1 UJ	0.1 U
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	1.3 U	- -	0.4 U	**0.34 J**	**4.7**	**0.82 J**	0.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.19 U	- -	0.2 U	0.1 U	0.1 U	0.1 UJ	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.19 U	- -	0.2 U	0.1 U	***1.1***	0.1 UJ	0.1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.19 U	- -	0.2 U	0.1 U	***0.88 J***	0.1 UJ	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.19 U	- -	0.2 U	0.1 U	***11 J***	0.1 UJ	0.1 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.19 U	- -	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.19 U	- -	0.2 U	0.2 U	**1.4 J**	0.2 UJ	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**0.27**	- -	0.2 U	0.1 U	***21 J***	0.1 UJ	0.1 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.19 U	- -	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**0.56**	- -	0.4 U	**0.071 J**	**3.8**	0.2 UJ	0.2 U
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.19 U	- -	0.2 U	0.1 U	**3.6 J**	**0.17 J**	0.1 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**8.3**	- -	**2.7**	**2.1**	**32 J**	**0.12 J**	0.1 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.19 U	- -	0.2 U	0.1 U	0.1 U	0.1 UJ	0.1 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***77.6***	- -	***13.5***	***6.5***	***300 J***	0.1 UJ	0.1 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.19 U	- -	0.2 U	0.1 U	0.1 U	0.1 UJ	0.1 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	**1960**	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***4220***	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.19 U	- -	0.2 U	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**538**	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-3						800-MW30	
					Sample ID	800MW03-010600	800-MW-3-051700	800-MW-3-20001121	800-MW-3-20010606	800-MW-3-20020615	800-MW-3-20040619	L800-MW30-0818	L800-MWF30-0818
					Sample Depth (ft)	69 - 79	69 - 79	69 - 79	69 - 79	69 - 79	69 - 79	10 - 20	10 - 20
					Sample Date	1/6/2000	5/17/2000	11/21/2000	6/6/2001	6/15/2002	6/19/2004	8/28/2018	8/28/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**472000**	- -	**452000**	**452000**	**480000**	**450000**	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**290**	- -	**120**	**110**	**120 J**	**50**	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**462000**	- -	**78000**	**130000**	**210000**	**800000**	- -	- -
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	**210**	- -	1000 U	1000 U	1000 U	1000 U	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	**3400**	1000 U	1000 U	1000 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**290**	- -	**500**	- -	**300**	1000 U	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1100**	- -	**1600**	**1000**	**1400**	**1100**	- -	- -
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**8200**	- -	**2300**	**2000**	**1000**	**1000**	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	10 U	**20**	**30**	50 U	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**14700**	- -	**10000**	**10000**	**11000**	**9000**	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.43 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	0.1 U	0.1 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.43 U	0.83 U	1.2 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.2 U	0.16 U	**0.22 J**	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.43 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.43 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.43 U	0.31 U	0.43 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.43 U	0.66 U	0.94 U	1.8 U	0.21 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.06 U	0.31 U	0.43 U	0.66 U	0.94 U	0.49 U	0.21 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.67 U	0.31 U	0.43 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.06 U	0.78 U	0.43 U	0.66 U	0.94 U	0.49 U	0.21 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.21 U	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.1 U	0.1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.06 U	0.39 U	0.43 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.43 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.93 U	0.16 U	0.4 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	11 U	0.31 U	0.43 U	0.66 U	0.94 U	0.49 U	0.1 U	0.1 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	2.7 U	4.6 U	- -	10 U	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**158**	**177**	- -	**146 J**	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.4 U	- -	5 U	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**92600**	- -	**91800**	**92500**	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	4.5 U	**13.3**	- -	10 U	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	3.4 U	3.9 U	- -	10 U	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**48000**	- -	**47900**	**48100**	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.08 U	0.1 U	- -	0.21 U	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	2.6 U	- -	10 U	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	4.1 U	2.8 U	- -	10 U	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**32100**	- -	**24300**	**23100**	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.43 U	0.66 U	0.94 U	0.49 U	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	10 U	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	3 U	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW31				800-MW-4			
					Sample ID	L800-MW31-0818	800MW04-010400	800-MW-4-052400	800-MW-4-20001025	800-MW-4-20010606	800-MW-4-20020614	800-MW-4-20040618	L800-MW4-0818
					Sample Depth (ft)	10 - 20	64 - 74	64 - 74	64 - 74	64 - 74	64 - 74	64 - 74	64 - 74
					Sample Date	8/28/2018	1/4/2000	5/24/2000	10/25/2000	6/6/2001	6/14/2002	6/18/2004	8/19/2018
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95(1))**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	- -	**458000**	- -	- -	- -	**450000**	**420000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	**290**	- -	- -	- -	**70**	**60**	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	**447000**	- -	- -	- -	**200000**	**100000**	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	**700**	- -	- -	- -	1000 U	1000 U	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	200 U	- -	- -	- -	**1000**	1000 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	100 U	- -	- -	- -	**1900**	**1200**	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	- -	620 U	- -	- -	- -	**1000**	**1200**	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	**20400**	- -	- -	- -	**10000**	**8000**	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	50 U	- -	- -	- -	**20**	50 U	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	- -	**44200**	- -	- -	- -	**56000**	**50000**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	**0.19 J**	0.03 U	0.16 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	***7.6 J***	- -	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**3.2**	- -	- -	0.53 U	0.42 U	0.75 U	0.49 U	0.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	***7.6 J***	0.04 U	0.16 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.11 U	0.05 U	0.16 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.11 U	0.05 U	0.31 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	***2.2 J***	0.03 U	0.31 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.21 U	0.06 U	0.31 U	0.53 U	0.34 U	0.6 U	0.49 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.21 U	0.51 U	0.31 U	0.53 U	0.34 U	0.6 U	0.49 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**0.4**	0.02 U	0.31 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.21 U	0.06 U	0.78 U	0.53 U	0.34 U	0.6 U	0.49 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**0.49 J**	- -	- -	- -	- -	- -	- -	0.2 U
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.11 UJ	- -	- -	- -	- -	- -	- -	0.1 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**1.3 J**	0.06 U	0.39 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	***0.36***	***2.6***	0.16 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***160***	0.05 U	0.16 U	0.5 U	0.34 U	0.6 U	0.49 U	**0.063 J**
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.11 U	0.03 U	0.31 U	0.53 U	0.34 U	0.6 U	0.49 U	0.1 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	**5.5**	**4.8 J**	- -	10 U	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	**233**	**217**	- -	**159 J**	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	0.64 U	**0.4 J**	- -	10 U	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	**136000**	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	**98.3**	**73.5**	- -	**1.1 J**	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	5.5 U	**2.5 J**	- -	2 U	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	**52700**	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	0.11 U	0.1 U	- -	0.21 U	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	2.9 U	**3.2 J**	- -	10 U	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	1.1 U	2.8 U	- -	10 U	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	**51000**	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	- -	0.02 U	0.16 U	0.53 U	0.34 U	0.6 U	0.49 U	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	10 U	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	10 U	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	3 U	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-5						
					Sample ID	800MW05-010500	800-MW-5-051600	800-MW-5-20001120	800-MW-5-20010614	800-MW-5-20010614-FD	800-MW-5-20020630	800-MW-5-20020630-FD
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	1/5/2000	5/16/2000	11/20/2000	6/14/2001	6/14/2001	6/30/2002	6/30/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**1260000**	- -	**1400000**	**1600000**	- -	**1200000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	***106000***	- -	***240000***	**12000**	- -	***150000***	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**1310000**	- -	- -	- -	- -	**530000**	- -
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	20 U	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	**240**	- -	1000 U	1000 U	- -	1000 U	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	**3800**	1000 U	- -	1000 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**111000**	- -	**240000**	**200000**	- -	**120000**	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**53800**	- -	**57000**	**60000**	- -	**43000**	- -
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**7700**	- -	**11000**	**10000**	- -	**10000**	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	***96400***	- -	***110000***	***150000***	- -	***62000***	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**52800**	- -	**46000**	**45000**	- -	**46000**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	16 U	**60 J**	**56**	**69**	**85 J**	**100 J**
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	**13 J**	**28 J**	**28**	42 U	58 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***13000***	***17000 J***	***18000 J***	***31000***	***33000***	***32000 J***	***30000 J***
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	16 U	***190 J***	1.3 U	1.1 U	***180 J***	***190 J***
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***350***	31 U	***93 J***	***81 J***	1.1 U	42 U	58 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***6100***	***4700 J***	***4100 J***	***4400***	***5000***	***7100 J***	***5600 J***
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	31 U	***1.4 J***	1.3 U	1.1 U	42 U	58 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.06 U	31 U	5.1 U	1.3 U	1.1 U	42 U	58 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.02 U	31 U	***2000 J***	***2400***	***2700***	***2100 J***	***2300 J***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	82 U	78 U	5.1 U	1.3 U	1.1 U	***72 J***	***88 J***
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	***19000***	**230**	5.1 U	**410 J**	**480**	**360 J**	**410 J**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	55 U	16 U	5.1 U	***1.1 J***	1.1 U	42 U	58 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***1200***	***1800 J***	***2300 J***	***3100***	***3200***	***2700 J***	***2900 J***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	2.8 U	31 U	5.1 U	**24 J**	1.1 U	42 U	58 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	**4.2**	2.5 U	- -	10 U	10 U	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**833**	**1020**	- -	***2020 J***	**939**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.3 U	- -	5 U	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**309000**	- -	**257000**	**227000**	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	***249***	**11.8**	- -	**1 J**	**0.5**	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**15.1**	**2.4 J**	- -	**5.3 J**	**7**	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**108000**	- -	**89600**	**84400**	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.12 U	0.1 U	- -	0.21 U	0.21 U	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	**4.9 J**	- -	**5.6 J**	**5.7**	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.1 U	**0.7 J**	- -	10 U	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**31700**	- -	**27600**	**33600**	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	**30**	16 U	**51 J**	**52**	**48**	**47 J**	58 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	150 U	150 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	150 U	150 U	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	150 U	150 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	150 U	150 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	150 U	150 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	500 U	500 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	150 U	150 U	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	500 U	500 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	150 U	150 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	150 U	150 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	150 U	150 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location		800-MW-5				800-MW-6		
					Sample ID	800-MW-29-FD	800-MW-5-20040617	F04-GW-013	800MW06-011200	800-MW-6-051600	D010-051600	800-MW-6-20001119	800-MW-6-20010617
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	6/17/2004	6/17/2004	11/11/2004	1/12/2000	5/16/2000	5/16/2000	11/19/2000	6/17/2001
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**1200000**	**1200000**	**1400000**	**355000**	- -	- -	**270000**	**270000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	***240000***	***180000***	- -	440 U	- -	- -	**40**	**100**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	**388000**	- -	- -	**200000**	**700000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	490 U	- -	- -	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	- -	**4900**	- -	- -	**2200**	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**160000**	**140000**	- -	100 U	- -	- -	**500**	**700**
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**46000**	**45000**	**48000**	620 U	- -	- -	**3700**	**3300**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**8000**	**9000**	**10000**	**3300**	- -	- -	**3400**	**4000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	***110000***	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	***110000***	***110000***	- -	**610**	- -	- -	**650**	**530**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	**100**	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**48000**	**48000**	**45000**	**43000**	- -	- -	**42000**	**40000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	**72**	**96**	**130 D**	0.03 U	0.16 U	0.2 U	1.1 U	0.62 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.49 U	0.5 U	**14 P**	- -	- -	- -	**13**	**13**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***20000***	***25000***	***27000 D***	0.04 U	0.16 U	0.2 U	***11***	0.62 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	***200***	***260***	***35***	2.6 U	0.16 U	0.2 U	- -	0.62 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***48***	***120***	***75 D***	0.05 U	0.31 U	0.4 U	***4.4***	***4.9***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***4300***	***4900***	***4600 D***	0.03 U	0.31 U	0.4 U	***2.1***	0.62 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.49 U	0.5 U	0.49 U	0.06 U	0.31 U	0.4 U	1.1 U	0.62 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.49 U	0.5 U	***3.4 P***	0.17 U	0.31 U	0.4 U	1.1 U	0.62 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***1800***	***2200***	0.49 U	**0.64**	0.31 U	0.4 U	***2.7***	***2.8***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.49 U	0.5 U	0.49 U	0.06 U	0.78 U	1 U	1.1 U	0.62 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	0.49 U	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	0.49 U	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**240**	**220**	**250 D**	41 U	**52 J**	**74 J**	**70**	**125**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.49 U	0.5 U	0.49 U	0.06 U	0.16 U	0.2 U	1.1 U	0.62 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***1800***	***2100***	***2300 D***	***1000***	***760 J***	***1400 J***	***1200***	***1100***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.49 U	0.5 U	0.49 U	0.37 U	0.31 U	0.4 U	1.1 U	0.62 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	20 U	**4.8 J**	20 U	2.7 U	2.5 U	2.5 U	- -	10 U
METALS	7440-39-3	Barium	µg/L	2000	430	**1050**	**1090 J**	**788**	**202**	**141**	**124**	- -	**188 J**
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	5 U	0.7 B	0.64 U	0.3 U	0.3 U	- -	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	**219000**	**99000**	- -	- -	**80100**	**68500**
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	10 U	0.93 B	**2.2**	2.5 U	2.5 U	- -	10 U
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	44.3 B	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	10 U	2.7 B	1.4 U	**2.4 J**	1.7 U	- -	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	**83800**	**30000**	- -	- -	**26400**	**27700**
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	***2230***	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.2 U	0.2 U	0.2 U	0.06 U	0.1 U	0.1 U	- -	0.21 U
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	10 U	5.6 B	2.9 U	**2.6 J**	**3.7 J**	- -	**2.7 J**
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	0.5 B	1.1 U	0.5 U	0.5 U	- -	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	**29900 E**	**13600**	- -	- -	**11400**	**12800**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	**82.6**	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	**41**	**54**	**40**	0.02 U	0.16 U	0.2 U	1.1 U	0.62 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	0.11 U	- -	- -	3 U	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	3 U	6 U
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	0.31 U	- -	- -	3 U	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	0.61 U	- -	- -	3 U	3 U
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	0.51 U	- -	- -	3 U	3 U
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	0.14 U	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	0.7 U	- -	- -	10 U	10 U
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	0.51 U	- -	- -	3 U	3 U
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	**3.6**	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	0.69 U	- -	- -	10 U	10 U
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	0.82 U	- -	- -	3 U	3 U
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	0.3 U	- -	- -	3 U	3 U
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	0.61 U	- -	- -	3 U	3 U

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-6							
					Sample ID	800-MW-6-20020629	800-MW-6-20040620	F04-GW-039	800-MW-6-FBL	800-MW-6-F01R1	L800-MW06-F01R3	800-MW-06-F01R4	L800-MW06-F01R5
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	6/29/2002	6/20/2004	11/15/2004	9/24/2007	12/10/2007	2/22/2008	3/18/2008	5/21/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**270000**	**200000**	**210000**	**268000**	**295000**	**310000**	**430000**	**448000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	**70**	40 U	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**120000**	**900000**	**3200**	**551000**	**718000**	**452000**	**729000**	**875000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	1000 U	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	300 U	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**3700**	**3200**	**2500**	**3100**	**2200**	**67700**	**83200**	**2700**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	**4000**	**2000**	**2000**	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	**1500**	**5400**	**4600**	**5300**	**5800**	**3900**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	**590**	**2200**	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	100 U	50 U	***3800***	50 U	50 U	50 U
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**41000**	**38000**	**40000**	**51200**	**46600**	**42800**	**43300**	**44000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.61 U	0.49 U	0.52 U	0.19 U	0.2 U	1 U	0.2 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**12**	**15**	**12**	**11.8**	**14.6**	**10.4**	**11.5**	**10.1**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	***2.7***	0.49 U	0.52 U	0.19 U	0.2 U	1 U	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.61 U	0.49 U	0.52 U	0.19 U	0.2 U	1 U	0.2 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	***4.9***	***6.8***	***4.8***	***4.9***	***4.5***	***3.8***	***3.9***	***2.9***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.61 U	0.49 U	**0.19 JP**	**0.12 J**	**0.12 J**	1 U	**0.12 J**	**0.12 J**
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.61 U	0.49 U	0.52 U	0.19 U	0.2 U	1 U	0.2 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.61 U	0.49 U	0.52 U	0.19 U	0.2 U	1 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	***5.7 J***	***4.9 J***	***4.4***	***4***	***3.5***	***2.7***	***3***	***2.4***
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.61 U	0.49 U	0.52 U	0.19 U	0.2 U	1 U	0.2 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	- -	**3.1 P**	0.19 U	**0.24**	1 U	0.2 U	0.2 U
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	**2.5 P**	**1.7**	**2.1**	**1.2**	**1.7**	**1**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**140 J**	**130**	**150 D**	**135**	**139**	**91.3**	**108**	**91.8**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.61 U	0.49 U	0.52 U	0.19 U	0.2 U	1 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***1100 J***	***1700***	***1400 D***	***1510***	***1610***	***1300***	***1430***	***986***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.61 U	0.49 U	0.52 U	0.19 U	0.2 U	1 U	0.2 U	0.2 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	15 U	15 U	15 U	15 U	15 U
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	**23.6**	**294**	**73**	**36.4**	**166**
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.61 U	**0.39 J**	**0.33 J**	**0.49**	**0.22**	1 U	**0.35**	**0.2**
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	**2 J**	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	10 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	**200**	- -	**20.2**	**0.95**	**2.35**	**7.92**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	10 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-6					800-MW-7		
					Sample ID	800-MW-6-F01R6	800-MW-6-F01R6-FD	800-MW-6-01R7	800-MW-6-F01R7	L800-MW-6-F01R9	800MW07-010600	800MW07-010900	800-MW-7-051700
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	27.5 - 37.5	27.5 - 37.5	27.5 - 37.5
					Sample Date	9/29/2008	9/29/2008	3/3/2009	3/5/2009	8/26/2009	1/6/2000	1/9/2000	5/17/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**239000**	**227000**	**517000**	- -	- -	**359000**	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	**290**	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**580000**	**295000**	**961000**	- -	- -	**349000**	- -	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	**220**	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	200 U	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	**590**	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**2300**	**2100**	**184000**	- -	**104000**	620 U	- -	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	**2800**	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	**2700**	**2800**	**240**	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	**1100**	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	50 U	50 U	**690**	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**41400**	**41100**	**11100**	- -	- -	**7900**	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	**783000**	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	**475000**	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	**157000**	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	**15900**	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	0.03 U	0.21 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**8.8**	**8.9**	1.5 U	- -	0.57 U	- -	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	2.6 U	0.21 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	0.05 U	0.21 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	***3.7***	***3.9***	0.38 U	- -	0.19 U	- -	0.05 U	0.42 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	1 U	0.42 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	0.06 U	0.42 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	0.26 U	0.42 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	***3.3***	***3.6***	0.19 U	- -	0.19 U	- -	0.33 U	0.42 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	0.06 U	1 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**0.061 J**	0.19 U	0.57 U	- -	0.19 U	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	**1.4**	**1.3**	0.38 U	- -	0.19 U	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**126**	**143**	**14**	- -	**4.8**	- -	0.12 U	0.52 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	0.06 U	0.21 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***1110***	***1160***	***121***	- -	***14.8***	- -	0.82 U	0.21 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	- -	0.03 U	0.42 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	2.7 U	- -	4.1 U
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	**266**	- -	**273**
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	**0.7**	- -	0.4 U
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	**89400**	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	**20.8**	- -	**3.4 J**
METALS	7439-89-6	Iron	μg/L	14000	9736	23 U	23 U	**6740**	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	2.2 U	- -	3.8 U
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	**24000**	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	**274**	**270**	***20900***	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	0.09 U	- -	0.1 U
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	2.9 U	- -	2.6 U
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	6.7 U	- -	2.8 U
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	**18800**	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	**0.24**	**0.22**	0.19 U	- -	0.19 U	- -	0.02 U	0.21 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	0.11 U	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	0.31 U	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	0.61 U	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	0.51 U	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	**1.2 J**	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	0.7 U	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	**1.2 J**	- -
VOLATILES	74828	Methane	μg/L	--	--	**13.4**	**11.6**	**67.4**	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	0.69 U	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	0.82 U	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	0.3 U	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	0.61 U	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
					Location	800-MW-7							
					Sample ID	800-MW-7-20001120	800-MW-7-20010606	800-MW-7-20020630	800-MW-7-20040618	800-MW-7-F01R1	L800-MW07-F01R2	800-MW7-F01R3	800-MW-07-F01R4
					Sample Depth (ft)	27.5 - 37.5	27.5 - 37.5	27.5 - 37.5	27.5 - 37.5	27.5 - 37.5	27.5 - 37.5	27.5 - 37.5	27.5 - 37.5
					Sample Date	11/20/2000	6/6/2001	6/30/2002	6/18/2004	12/5/2007	1/10/2008	2/15/2008	3/13/2008
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**320000**	**330000**	**190000**	**330000**	**388000**	**343000**	**350000**	**368000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**470**	**510**	**600**	**570**	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**45000**	**100000**	**84000**	**95000**	**464000**	**474000**	**407000**	**531000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**800**	**800**	**1000**	1000 U	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1100**	**1000**	**1600**	**1000**	**1300**	**38100**	**54700**	**61400**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**3600**	**4000**	**3000**	**4000**	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	50 U	**230**	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	10 U	10 U	**20**	50 U	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	***3100***	***2800***	50 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**7900**	**8000**	**60000**	**10000**	**11000**	**12600**	**16800**	**17000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.18 U	1.2 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	**0.29**	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.18 U	1 U	0.47 U	**0.93**	0.19 U	0.2 U	0.2 U	**0.094 J**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.17 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	**0.071 J**	0.19 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**300**	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	5 U	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**85000**	**90300**	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	**2.4 J**	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	**1820**	**948**	**672**	**572**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**21600**	**23200**	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	***2580***	***1520***	***1230***	***1100***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.21 U	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	10 U	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**14900**	**16700**	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.18 U	1 U	0.47 U	0.49 U	0.19 U	0.2 U	0.2 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	3 U	3 U	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	3 U	3 U	3 U	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	3 U	3 U	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	3 U	3 U	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	3 U	3 U	3 U	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	10 U	10 U	10 U	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	3 U	3 U	3 U	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	**3.89**	**8.14**	**41.2**	**57.2**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	10 U	10 U	10 U	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	3 U	3 U	3 U	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	3 U	3 U	3 U	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	3 U	3 U	3 U	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-7			800-MW-8				
					Sample ID	800-MW-07-F01R4-FD	L800-MW07-F01R5	L800-MW7-0818	800MW08-011200	800-MW-8-051100	800-MW-8-20001023	800-MW-8-20010607	800-MW-8-20020627
					Sample Depth (ft)	27.5 - 37.5	27.5 - 37.5	27.5 - 37.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	3/13/2008	5/21/2008	8/19/2018	1/12/2000	5/11/2000	10/23/2000	6/7/2001	6/27/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**363000**	**438000**	- -	**216000**	- -	**210000**	**180000**	**200000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	290 U	- -	10 U	10 U	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**498000**	**824000**	- -	**204000**	- -	**28000**	**55000**	**88000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	330 U	- -	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	200 U	- -	1000 U	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	880 U	- -	300 U	300 U	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**67200**	**1400**	- -	620 U	- -	1000 U	1000 U	1000 U
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	**2000**	- -	**1100**	**3000**	**7000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	50 U	50 U	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	50 U	- -	**20**	**130**	**300**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	50 U	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**16800**	**17900**	- -	**27800**	- -	**23000**	**22000**	**22000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.19 U	0.1 U	0.03 U	0.18 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	0.1 U	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	0.19 U	0.1 U	- -	- -	1.7 U	1.4 U	0.25 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.19 U	0.1 U	0.04 U	0.18 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.19 U	0.1 U	0.05 U	0.18 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.19 U	0.1 U	0.05 U	0.36 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.19 U	0.1 U	0.03 U	0.36 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.19 U	0.2 U	0.06 U	0.36 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.19 U	0.19 U	0.2 U	0.12 U	0.36 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.19 U	0.1 U	0.02 U	0.36 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.19 U	0.2 U	0.06 U	0.91 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	0.19 U	0.2 U	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	0.19 U	0.1 U	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**0.12 J**	**0.3**	0.1 U	0.06 U	**0.69**	1.7 U	**0.69 J**	**1 J**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.19 U	0.1 U	0.06 U	0.21 U	1.7 U	1.2 U	0.25 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	**0.19**	0.1 U	***17***	**1.1**	**1.4 J**	**1.6**	**1.4**
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.19 U	0.1 U	0.03 U	0.36 U	1.7 U	1.2 U	0.25 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	2.7 U	**6.9 J**	- -	10 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	**83.2**	**200**	- -	**81.3 J**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	0.64 U	0.4 U	- -	5 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	**54300**	- -	- -	**50500**	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	1.2 U	**28.1**	- -	**2.9 J**	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	**583**	226 B	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	1.4 U	**12.3**	- -	10 U	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	**20800**	- -	**18000**	**19400**	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	***1100***	***1010***	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	0.06 U	0.1 U	- -	0.21 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	2.9 U	2.6 U	- -	10 U	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	1.1 U	2.8 U	- -	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	**11800**	- -	**9040**	**9460**	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.19 U	- -	0.02 U	0.18 U	1.7 U	1.2 U	0.25 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	**1000**	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	10 U	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	74828	Methane	µg/L	--	--	**54.8**	**3.63**	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	10 U	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	3 U	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	**3**	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
					Location	800-MW-8				800-MW-9			
					Sample ID	800-MW-8-20040606	F04-GW-045	800-MW-8-FBL	L800-MW8-0818	800MW09-011700	800-MW-9-051100	800-MW-9-20001025	800-MW-9-20010607
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5
					Sample Date	6/6/2004	11/15/2004	3/21/2007	8/19/2018	1/17/2000	5/11/2000	10/25/2000	6/7/2001
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**196000**	**200000**	**213000**	- -	**250000**	- -	**200000**	**180000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	40 U	- -	- -	- -	290 U	- -	**20**	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**150000**	**6000**	**416000**	- -	**233000**	- -	**84000**	**160000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	- -	- -	300 U	- -	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	- -	- -	- -	200 U	- -	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	1000 U	- -	- -	- -	**1800**	- -	**300**	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000 U	790 B	- -	620 U	- -	1000 U	1000 U
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**9000**	**10000**	- -	- -	**8800**	- -	**10000**	**12000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	**400**	**580**	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**370**	- -	- -	- -	50 U	- -	**10**	30 U
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	100 U	50 U	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**22000**	**21000**	**26000**	- -	**33900**	- -	**37000**	**30000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.49 U	0.53 U	0.19 U	0.1 U	0.03 U	0.16 U	0.65 U	0.91 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	0.1 U	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.49 U	**0.15 J**	**0.12 J**	**0.15 J**	- -	- -	0.65 U	1.1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.49 U	0.53 U	0.19 U	0.1 U	0.04 U	0.16 U	0.65 U	0.91 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.49 U	0.53 U	0.19 U	0.1 U	0.05 U	0.16 U	0.65 U	0.91 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.49 U	0.53 U	0.19 U	0.1 U	0.05 U	0.31 U	0.65 U	0.91 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.49 U	0.53 U	0.19 U	0.1 U	0.03 U	0.31 U	0.65 U	0.91 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	8.2 U	0.53 U	0.19 U	0.2 U	0.06 U	0.31 U	0.65 U	0.91 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.49 U	0.53 U	0.19 U	0.2 U	0.06 U	0.31 U	0.65 U	0.91 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.49 U	0.53 U	0.19 U	0.1 U	0.02 U	0.31 U	0.65 U	0.91 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.49 U	0.53 U	0.19 U	0.2 U	0.06 U	0.78 U	0.65 U	0.91 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	0.53 U	0.19 U	0.2 U	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.53 U	0.19 U	0.1 U	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**1.2**	**0.73**	**0.64**	**0.48**	0.07 U	**0.39**	0.65 U	0.91 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.49 U	0.53 U	0.19 U	0.1 U	0.06 U	0.16 U	0.65 U	0.91 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***2.3***	**1.6**	**1.4**	**1.7**	0.05 U	0.16 U	0.61 U	0.91 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.49 U	0.53 U	0.19 U	0.1 U	0.03 U	0.31 U	0.65 U	0.91 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	2.7 U	2.4 U	- -	10 U
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	**242**	**205**	- -	**154 J**
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	0.64 U	0.4 U	- -	5 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	**69600**	- -	**56300**	**48600**
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	**9.4**	**5 J**	- -	**0.8 J**
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	15 U	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	**5**	**1.9 J**	- -	10 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	**25400**	- -	**20400**	**20600**
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	**137**	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	0.06 U	0.1 U	- -	0.21 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	2.9 U	2.6 U	- -	10 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	1.1 U	2.8 U	- -	10 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	**10400**	- -	**8550**	**8790**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.49 U	0.53 U	0.19 U	- -	0.53 U	0.16 U	0.65 U	0.91 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	**12**
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	**2**
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	**3**
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	10 U
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	3 U
VOLATILES	74828	Methane	µg/L	--	--	- -	**0.6 J**	**2.18**	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	10 U
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	3 U
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	800-MW-9				G-17					
					Sample ID	800-MW-9-20020614	800-MW-9-20040606	800-MW-9-FBL	L800-MW9-0818	G17-010500	G-17-051900	G-17-20001120	G-17-20010618	G-17-20020613	G-17-20040609
					Sample Depth (ft)	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	7.5 - 17.5	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19
					Sample Date	6/14/2002	6/6/2004	3/19/2007	8/18/2018	1/5/2000	5/19/2000	11/20/2000	6/18/2001	6/13/2002	6/9/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**190000**	**150000**	**177000**	- -	**204000**	- -	**190000**	**170000**	**170000**	**170000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	40 U	- -	- -	**290**	- -	10 U	10 U	10 U	40 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**84000**	**360000**	**390000**	- -	**193000**	- -	**30000**	**260000**	**75000**	**450000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	4 U	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	- -	- -	**280**	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	- -	- -	200 U	- -	1000 U	1000 U	**3000**	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	1000 U	- -	- -	100 U	- -	300 U	300 U	300 U	1000 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1200**	**1200**	**4500**	- -	620 U	- -	**1400**	**1000**	**2100**	**1100**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**15000**	**20000**	- -	- -	**6800**	- -	**7000**	**2000**	**2000**	**3000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	**430**	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	10 U	50 U	- -	- -	50 U	- -	**100**	**60**	10 U	50 U
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	50 U	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**35000**	**35000**	**37500**	- -	**42500**	- -	**44000**	**11000**	**26000**	**36000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.4 U	0.49 U	0.19 U	0.1 U	0.03 U	0.16 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	0.1 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.5 U	0.49 U	0.19 U	0.1 U	- -	- -	**2.9**	**1.8 J**	**1.1**	**1.5**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.4 U	0.49 U	0.19 U	0.1 U	0.04 U	0.16 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.4 U	0.49 U	0.19 U	0.1 U	0.05 U	0.16 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.4 U	0.49 U	0.19 U	0.1 U	0.05 U	0.31 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.4 U	0.49 U	0.19 U	0.1 U	0.03 U	0.31 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.4 U	0.77 U	0.19 U	0.2 U	0.06 U	0.31 U	1.7 U	0.39 U	0.69 U	5.8 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.4 U	0.49 U	0.19 U	0.2 U	0.49 U	0.31 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.4 U	0.49 U	0.19 U	0.1 U	0.02 U	0.31 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.4 U	0.49 U	0.19 U	0.2 U	0.06 U	0.78 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	0.19 U	0.2 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	0.19 U	0.1 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.4 U	0.49 U	0.19 U	**0.13 J**	15 U	**11**	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.4 U	0.49 U	0.19 U	0.1 U	0.06 U	0.16 U	1.7 U	0.39 U	0.69 U	0.48 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.4 U	0.49 U	0.19 U	**0.065 J**	***29***	***36***	***34***	***18***	***16***	***18***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.4 U	0.49 U	0.19 U	0.1 U	0.03 U	0.31 U	1.7 U	0.39 U	0.69 U	0.48 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	2.7 U	2.5 U	- -	10 U	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	**120**	**112**	- -	**100 J**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	0.64 U	0.3 U	- -	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	**53200**	- -	**58000**	**37000**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	3.3 U	**6.1 J**	- -	10 U	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	15 U	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	2.8 U	**3.5 J**	- -	10 U	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	**25600**	- -	**26500**	**21200**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	**36.2**	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	0.07 U	0.1 U	- -	0.21 U	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	2.9 U	**3.3 J**	- -	**3.8 J**	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	4.2 U	0.5 U	- -	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	**9900**	- -	**8410**	**7450**	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.4 U	0.49 U	0.19 U	- -	0.02 U	0.16 U	1.7 U	0.39 U	0.69 U	0.48 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	6 U	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	**21.7**	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	F04-GW-023	G-17-FBL	G-17-F01R1	G-17-F01R2	G-17-F01R3	G-17-F01R4	G-17-F01R4A	G-17-F01R5	L800-G17-0818	G18-010700	G-18-051800	G-18-20001129
					Location					G-17						G-18	
					Sample Depth (ft)	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19
					Sample Date	11/12/2004	3/19/2007	12/17/2007	1/16/2008	2/22/2008	3/17/2008	3/27/2008	5/20/2008	8/19/2018	1/7/2000	5/18/2000	11/29/2000
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**170000**	**180000**	**700000**	**161000**	**140000**	**160000**	**253000**	**278000**	--	**120000**	--	**100000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	--	--	--	--	--	--	--	--	--	590 U	--	**80**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**7100**	**183000**	**784000**	**191000**	**208000**	**252000**	**379000**	**543000**	--	**109000**	--	**160000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	--	--	--	--	--	--	--	--	--	--	--	--
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	--	--	--	--	--	--	--	--	270 U	--	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	--	--	--	--	--	--	--	--	--	200 U	--	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	--	--	--	--	--	--	--	--	--	590 U	--	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1400**	**1100**	**16700**	500 U	**25800**	**33400**	--	**1400**	--	**11200**	--	**8400**
GENERAL	1011	Specific conductance	µS/cm	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ANIONS	16887-00-6	Chloride	µg/L	--	--	**3000**	--	--	--	--	--	--	--	--	**3700**	--	**3800**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	--	--	--	--	--	--	--	--	--	--	--	--
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	200 U	**130**	**180**	50 U	90 B	--	**100**	50 B	--	--	--	--
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	--	--	--	--	--	--	--	--	--	***29600***	--	***35000***
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	100 U	50 U	***1800***	***1700***	50 U	--	50 U	50 U	--	--	--	--
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**29000**	**44400**	**40500**	**38900**	**31500**	**36500**	**36800**	**32400**	--	**40700**	--	**39000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BACTERIA	ARCHEA	Archea	cells/mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	0.1 U	**100**	**200**	**100**
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	--	--	--	--	--	--	--	--	0.1 U	--	--	--
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**1.1**	**2.2**	**2.1**	**1.4**	**0.4**	**1.1**	--	**0.62**	**3.6**	--	--	**31**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.5 U	0.19 U	0.19 U	0.2 U	**0.24**	0.2 U	--	0.19 U	0.1 U	***1300***	***1200***	***980***
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	0.1 U	0.05 U	16 U	***14***
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	0.1 U	***34***	32 U	***29***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.5 U	0.19 U	0.19 U	0.2 U	**0.19 J**	**0.11 J**	--	**0.092 J**	0.1 U	***130***	***62***	***51***
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	0.21 U	0.06 U	32 U	0.55 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	0.21 U	0.06 U	32 U	0.55 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.5 U	0.19 U	**0.22**	**0.21**	**0.76**	**0.39**	--	**0.33**	0.1 U	***36***	***470***	***68***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	0.21 U	0.06 U	80 U	0.55 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**5.6**	**15.1**	**12**	**7.9**	**1.6**	**4.7**	--	**2.6**	**30**	--	--	--
EXPLOSIVES	DNX	DNX	µg/L	--	--	**0.53 P**	**1**	**1.1**	**0.67**	**0.13 J**	**0.47**	--	**0.25**	**1.7**	--	--	--
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	**0.12 J**	--	0.19 U	0.1 U	**920**	**1000**	**890**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	0.1 U	0.06 U	16 U	0.55 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***14***	***24.7***	***24.5***	***17.2***	***5.1***	***14.8***	--	***7.1***	***43***	***2700***	***4300***	***4200***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	0.1 U	0.03 U	32 U	0.55 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	--	--	--	--	--	--	--	--	--	2.7 U	3.1 U	--
METALS	7440-39-3	Barium	µg/L	2000	430	--	--	--	--	--	--	--	--	--	**183**	**77**	--
METALS	7440-43-9	Cadmium	µg/L	5	5	--	--	--	--	--	--	--	--	--	0.64 U	0.4 U	--
METALS	7440-70-2	Calcium	µg/L	--	119033	--	--	--	--	--	--	--	--	--	**49000**	--	**49100**
METALS	7440-47-3	Chromium	µg/L	100	31	--	--	--	--	--	--	--	--	--	**8.1**	**2.3 J**	--
METALS	7439-89-6	Iron	µg/L	14000	9736	--	66.9 B	15 U	86.3 B	205 B	15 U	--	15 U	--	--	--	--
METALS	7439-92-1	Lead	µg/L	15	18.05	--	--	--	--	--	--	--	--	--	**2.8**	3.6 U	--
METALS	7439-95-4	Magnesium	µg/L	--	45243	--	--	--	--	--	--	--	--	--	**25400**	--	**24500**
METALS	7439-96-5	Manganese	µg/L	430	579.7	--	8.5 B	4.5 B	5.5 B	**28.1**	4.1 B	--	**15**	--	--	--	--
METALS	7439-97-6	Mercury	µg/L	2	1	--	--	--	--	--	--	--	--	--	0.06 U	0.1 U	--
METALS	7782-49-2	Selenium	µg/L	50	10	--	--	--	--	--	--	--	--	--	2.9 U	2.6 U	--
METALS	7440-22-4	Silver	µg/L	130	10	--	--	--	--	--	--	--	--	--	1.1 U	2.8 U	--
METALS	7440-23-5	Sodium	µg/L	--	42581	--	--	--	--	--	--	--	--	--	**25500**	--	**20700**
METALS	7440-66-6	Zinc	µg/L	6000	789	--	--	--	--	--	--	--	--	--	--	--	--
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.5 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	--	0.19 U	--	18 U	**48**	**39**
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	--	--	--	--	--	--	--	--	--	0.11 U	--	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	--	--	--	--	--	--	--	--	--	--	--	**110**
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	--	--	--	--	--	--	--	--	--	0.31 U	--	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	--	--	--	--	--	--	--	--	--	0.61 U	--	3 U
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	--	--	--	--	--	--	--	--	--	0.51 U	--	3 U
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	--	--	--	--	--	--	--	--	--	0.14 U	--	--
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	--	--	--	--	--	--	--	--	--	**3.2 J**	--	10 U
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	--	--	--	--	--	--	--	--	--	0.51 U	--	3 U
VOLATILES	74828	Methane	µg/L	--	--	0.87 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	--	0.5 U	--	--	--	--
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	--	--	--	--	--	--	--	--	--	**3.2 J**	--	10 U
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	--	--	--	--	--	--	--	--	--	0.82 U	--	3 U
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	--	--	--	--	--	--	--	--	--	--	--	--
VOLATILES	108-88-3	Toluene	µg/L	1000	--	--	--	--	--	--	--	--	--	--	**1.1 J**	--	3 U
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	--	--	--	--	--	--	--	--	--	0.61 U	--	3 U

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	G-18-20010612	G-18-20010612-FD	G-18-20020630	G-18-20020630-FD	G-18-20040616	G-18-20040616-FD	G-18	G-18-160605	G18-01R2	G-18-01R3	G-18-01R4
					Location	G-18										
					Sample Depth (ft)	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19
					Sample Date	6/12/2001	6/12/2001	6/30/2002	6/30/2002	6/16/2004	6/16/2004	5/19/2005	6/16/2005	7/13/2005	8/25/2005	11/8/2005
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	87200	87200	92000	92000	84000	84000	100000	100000	270000	427000	2500 U
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	40 U	10 U	50	30	40 U	40 U	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	290000	210000	40480	40480	500000	500000	75000	280000	- -	658000	5000 U
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	4 U	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	700	300 U	900	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	2000	7900	6900	7000	5700	5600	5300	79000	140000	234000	741000
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	3000	3000	3000	3000	3000	3000	- -	3000	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	200 U	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	2500	200 U	200 U	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	18000	17000	11000	11000	9800	9800	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	100 U	100 U	1000 U	810	2200
ANIONS	14808-79-8	Sulfate	µg/L	--	--	44000	44000	48000	48000	67000	67000	89000	89000	1000	1100 B	7100
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	160	206	170 J	200 J	150	150	130 D	0.53 U	0.49 U	0.19 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	33.9	52	20 U	29 U	21	20	15	13	0.49 U	0.19 U	0.2 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1500	1700	1300 J	1400 J	980	970	800 D	0.53 U	0.49 U	0.19 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.34 U	1 U	30 J	42 J	34	38	26	0.53 U	0.49 U	0.19 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	28	39	20 U	29 U	240	130	15	0.27 JP	0.49 U	0.19 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	67.6	66	59 J	- -	57	55	95 D	0.53 U	0.49 U	0.19 U	0.2 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.34 U	1 U	20 U	29 U	0.48 U	0.48 U	0.48 U	0.53 U	0.49 U	0.19 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.34 U	1 U	20 U	29 U	0.48 U	0.48 U	0.48 U	0.53 U	0.21 JP	0.19 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	85	100	69 J	68 J	73	70	55 DP	16	0.49 U	0.14 J	0.2 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.34 U	1 U	20 U	29 U	0.48 U	0.48 U	0.48 U	0.53 U	0.49 U	0.19 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	5.3 P	11	55 D	506	222
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	6:00 PM	0.87 P	0.19 U	0.2 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	940	1100	940 J	1000 J	930	860	680 D	700 D	0.88 P	0.19 U	0.2 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.34 U	1 U	20 U	29 U	0.48 U	0.48 U	0.48 U	0.29 JP	0.49 U	0.19 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	3700	4500	5400 J	4700 J	3200	3000	2100 D	360 D	0.77	0.19 U	0.2 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.34 U	1 U	20 U	29 U	0.48 U	0.48 U	0.48 U	0.53 U	0.49 U	0.19 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	3.9	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	126 J	1300	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	34400	34200	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	2.8 J	3.4	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	236 N	703	3150	10700	27200
METALS	7439-92-1	Lead	µg/L	15	18.05	6.1 J	6.5	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	18100	18500	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	85.6	555	1070	1610	2660
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	0.21 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.7 J	3.4	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	17500	22100	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	15	18	16 J	24 J	19	21	11	0.53 U	0.49 U	0.19 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	3 U	- -	- -	- -	- -	1 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	3 U	78	- -	- -	- -	- -	15	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	3 U	- -	- -	- -	- -	1 U	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	3 U	- -	- -	- -	- -	1 U	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	3 U	3 U	- -	- -	- -	- -	1 U	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	10 U	10 U	- -	- -	- -	- -	5 U	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	3 U	3 U	- -	- -	- -	- -	1 U	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	5.5	22	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	10 U	10 U	- -	- -	- -	- -	5 U	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	3 U	3 U	- -	- -	- -	- -	1 U	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	3 U	3 U	- -	- -	- -	- -	1 U	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	3 U	3 U	- -	- -	- -	- -	1 U	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	G-18			G-19								
					Sample ID	G-18-02R1	G-18-02R2	G-18-FBL	G19-010800	G-19-051800	G-19-20001119	G-19-20010619	G-19-20020630	G-19-20040616	G-19-FBL	G-19-F01R1	G-19-F01R2
					Sample Depth (ft)	9 - 19	9 - 19	9 - 19	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5
					Sample Date	2/2/2006	4/7/2006	3/20/2007	1/8/2000	5/18/2000	11/19/2000	6/19/2001	6/30/2002	6/16/2004	3/21/2007	12/5/2007	1/11/2008
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**970000**	**263000**	**167000**	**174000**	- -	**160000**	**240000**	**350000**	**160000**	**97000**	**142000**	**115000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	**290**	- -	10 U	**10**	10 U	**50**	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**5100000**	**1280000**	**222000**	**198000**	- -	**160000**	**100000**	**150000**	**950000**	**194000**	**169000**	**138000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	4 U	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	10 U	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	200 U	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	**290**	- -	**500**	**400**	**700**	1000 U	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**940000**	**794000**	**1600**	620 U	- -	**5900**	**3700**	**3700**	**3000**	**3500**	**3900**	500 U
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	**4000**	- -	**2700**	**4000**	**3000**	**4000**	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	50 U	50 U	**920**	- -	- -	- -	- -	- -	- -	**4900**	**200**	**1100**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	**6600**	- -	**2800**	**5200**	**2100**	**5500**	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	50 U	50 U	- -	- -	- -	- -	- -	- -	50 U	***1600***	***1400***
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**12000**	**7100**	**35400**	**43400**	- -	**47000**	**44000**	**9000**	**65000**	**49000**	**35800**	**34400**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.22 U	0.19 U	18 U	**26**	**22**	**3.8**	**5**	**2 J**	**0.28**	0.2 U	1 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.2 U	0.22 U	0.19 U	- -	- -	**12**	**17**	0.71 U	**7 J**	**2.2**	**2.8**	**0.54 J**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	0.22 U	0.19 U	440 U	***460***	***450***	***300***	***250***	***120***	***29***	**1.7**	***5.3***
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.22 U	0.19 U	0.05 U	1.6 U	***42***	***7.2***	***12***	0.49 U	***0.88***	***0.32***	***0.61 J***
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.2 U	0.22 U	0.19 U	***35***	3.1 U	***15***	***12***	0.71 U	***40 J***	***2.1***	***0.72***	***0.37 J***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.2 U	**0.27**	0.19 U	***54***	3.1 U	***40***	***36***	***79***	***32 J***	***13.4***	***8.3***	***6.2***
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.22 U	0.19 U	0.06 U	3.1 U	1.2 U	18 U	0.71 U	0.49 U	0.19 U	0.2 U	1 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.2 U	0.22 U	0.19 U	0.06 U	3.1 U	1.2 U	18 U	0.71 U	0.49 U	0.19 U	0.2 U	1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.2 U	**0.8**	0.19 U	***56***	***55***	***71***	***72.6***	***54 J***	***52***	***25.2***	***14.6***	***8.8***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.22 U	0.19 U	15 U	***14***	1.2 U	0.36 U	0.71 U	0.49 U	0.19 U	0.2 U	1 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**139**	**157**	0.19 U	- -	- -	- -	- -	- -	- -	**0.36**	**1.2**	1 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.2 U	0.22 U	0.19 U	- -	- -	- -	- -	- -	- -	**0.45**	**0.54**	1 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.2 U	0.22 U	0.19 U	**430**	**490**	**440**	**400**	**480**	**310**	**136**	**70**	**47.5**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.2 U	0.22 U	0.19 U	14 U	1.6 U	1.2 U	18 U	0.71 U	0.49 U	0.19 U	0.2 U	1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.2 U	0.22 U	0.19 U	***1400***	***1100***	***1200***	***1200***	***1400***	***680***	***229***	***132***	***48.6***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	0.22 U	0.19 U	0.68 U	3.1 U	1.2 U	***72.6***	0.71 U	0.49 U	0.19 U	0.2 U	1 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	2.7 U	4.1 U	- -	**4.8 J**	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	**165**	**151**	- -	**1050**	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	0.64 U	0.4 U	- -	5 U	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	**56600**	- -	**49400**	**62600**	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	**18.2**	1.8 U	- -	**1.3 J**	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	***41400***	***29100***	146 B	- -	- -	- -	- -	- -	- -	15 U	56 B	18.3 B
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	1.4 U	1.7 U	- -	**3.3 J**	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	**20000**	- -	**17400**	**23100**	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	***7480***	***4450***	**79.6**	- -	- -	- -	- -	- -	- -	**18.8**	***879***	**78.9**
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	0.06 U	0.1 U	- -	0.21 U	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	2.9 U	2.6 U	- -	10 U	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	1.1 U	2.8 U	- -	10 U	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	**15500**	- -	**11700**	**18100**	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.2 U	0.22 U	0.19 U	16 U	**23**	**19**	**5.3**	**5**	**2**	**0.71**	**0.3**	1 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	**2**	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	**0.84**	- -	- -	- -	- -	- -	- -	**0.6**	0.5 U	0.5 U
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-19										
					Sample ID	G-19-F01R2-FD	G-19-F01R3	G-19-F01R3-FD	G-19-F01R4	G-19-F01R5	G-19-F01R5-FD	G-19-F01R6	G-19-01R7	G-19-01R7-FD	G-19-F01R7	G-19-F01R7-FD
					Sample Depth (ft)	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5
					Sample Date	1/11/2008	2/19/2008	2/19/2008	3/12/2008	5/20/2008	5/20/2008	9/30/2008	3/5/2009	3/5/2009	3/6/2009	3/6/2009
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**											
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**117000**	**119000**	**103000**	**130000**	**153000**	**137000**	**140000**	**185000**	**182000**	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**122000**	**159000**	**129000**	**211000**	**319000**	**275000**	**179000**	**192000**	**192000**	- -	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**26400**	**27500**	**27700**	**28300**	**4100**	**4000**	**3300**	**29600**	**28300**	- -	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	**1100**	**690**	**700**	**430**	**330**	**340**	**120**	**200**	**200**	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	***1400***	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**34500**	**29900**	**30000**	**30300**	**33200**	**33600**	**35800**	**33000**	**33100**	- -	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**96200**	**110000**
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**167000**	**253000**
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**27300**	**68300**
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**27700**	**49900**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	1 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.57 U	3.8 U	- -	- -
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**0.53 J**	**0.78**	**0.6**	**0.84**	**0.94**	**1**	**0.38**	**1.2**	**1.2**	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	***4.7***	***10.9***	***6.4***	***9.9***	***3.3***	***3.8***	**0.78**	**2.4**	***3.5***	- -	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	1 U	***0.78***	***0.4***	***0.68***	***0.37***	***0.44***	***0.33***	**0.14 J**	**0.19**	- -	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	1 U	***0.48***	***0.48***	***0.49***	***0.51***	***0.54***	***0.2***	***0.7***	***0.71***	- -	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	***6.3***	***7.8***	***6.8***	***7.2***	***9***	***9.3***	***3.9***	***7***	***6.8***	- -	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	1 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	- -
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	1 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	***8.9***	***12.1***	***10.6***	***12.7***	***14.6***	***15***	***5.4***	***12.4***	***12.5***	- -	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	1 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	- -
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	1 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U	**0.53 J**	0.19 U	0.19 U	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	1 U	**0.15 J**	0.2 U	**0.21**	**0.2**	**0.16 J**	**0.16 J**	0.38 U	0.38 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**48.2**	**55.1**	**44.3**	**62**	**55.2**	**54.8**	**76.6**	**61.2**	**63.3**	- -	- -
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	1 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***47.8***	***84.1***	***61.5***	***100***	***83***	***76.9***	***25.7***	***105***	***108***	- -	- -
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	1 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	16 B	101 B	96.8 B	87.7 B	17 B	15 U	133 B	23 U	23 U	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	**78.1**	**80.2**	**79.2**	**57.4**	**55.1**	**56.4**	**519**	**77.1**	**79.2**	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	**2.1**	**0.58**	**0.4**	**0.63**	**0.38**	**0.33**	**0.1 J**	**0.19**	**0.3**	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	0.5 U	0.5 U	0.5 U	**0.23 J**	**0.2 J**	0.5 U	**1.82**	**8.48**	**8.79**	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-19					G-20				
					Sample ID	G-19-F01R9	G-20-051800	G-20-20001025	G-20-20010618	G-20-20010618-FD	G-20-20020613	G-20-20020613-FD	800-MW-28-FD	G-20-20040616	G-20-20040618
					Sample Depth (ft)	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5
					Sample Date	8/28/2009	5/18/2000	10/25/2000	6/18/2001	6/18/2001	6/13/2002	6/13/2002	6/16/2004	6/16/2004	6/18/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	**260000**	**260000**	**260000**	**260000**	**260000**	**240000**	- -	**280000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	**810**	**30**	**40**	**300**	**380**	**70**	- -	**120**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	**60000**	- -	- -	**110000**	**110000**	**90000**	- -	**100000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	4 U	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	**4100**	1000 U	1000 U	1000 U	1000 U	1000 U	- -	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	1200 U	300 U	300 U	300 U	300 U	1000 U	- -	1000 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1300**	- -	**8000**	**7400**	**7400**	**7200**	**6800**	**6700**	- -	**6000**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	**8400**	**13000**	**13000**	**11000**	**12000**	**11000**	- -	**11000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	***75000***	***130000***	***110000***	***96000***	***89000***	***73000***	- -	***75000***
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	**54000**	**56000**	**55000**	**61000**	**61000**	**74000**	- -	**72000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	***1300***	***2100 J***	***1600***	***1500***	***1600***	***1600***	***1400***	***1400***	- -
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**1.5**	- -	**120 J**	**106**	**58**	36 U	28 U	**35**	**36**	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***4.1***	16 U	***92 J***	***106***	***125***	***50 J***	***47***	***39***	***46***	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	***0.89***	16 U	***54 J***	0.53 U	0.62 U	***97 J***	***91 J***	0.48 U	0.48 U	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***1***	31 U	1.1 U	***18***	***14***	***170***	***150***	***65***	***76***	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***9.8***	***41***	***53 J***	***50***	***40***	***41 J***	***38 J***	***42***	***45 J***	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	31 U	1.1 U	0.53 U	0.62 U	29 U	22 U	0.48 U	0.48 U	- -
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.2 U	31 U	1.1 U	0.53 U	0.62 U	29 U	22 U	0.48 U	0.48 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***15.2***	31 U	1.1 U	***20***	***16***	***21 J***	***20 J***	***21***	***22***	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	78 U	1.1 U	0.53 U	0.62 U	29 U	22 U	0.48 U	**0.28 J**	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.6 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.4 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**94.5**	***1600***	***1600 J***	***1700***	***1600***	***1800 J***	***1600 J***	***1400***	***1400***	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.2 U	16 U	1.1 U	0.53 U	0.62 U	29 U	22 U	0.48 U	0.48 U	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***129***	***12000***	***12000 J***	***14000***	***13000***	***14000***	***14000***	***13000***	***13000***	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	31 U	***41 J***	**17**	**14**	29 U	22 U	0.48 U	0.48 U	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	2.4 U	- -	10 U	**3.4**	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**176**	- -	**259**	**255**	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	0.4 U	- -	5 U	5 U	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	**121000**	**166000**	**167000**	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	1.8 U	- -	**2.9 J**	10 U	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	1.7 U	- -	10 U	10 U	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	**53200**	**77200**	**76300**	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.1 U	- -	0.21 U	0.21 U	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	2.6 U	- -	**2.6 J**	10 U	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	2.8 U	- -	10 U	10 U	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	**34300**	**35700**	**35100**	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	**0.68**	**39**	1.1 U	0.53 U	0.62 U	**29 J**	**28**	**3.4**	**7 J**	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	3 U	**3**	150 U	150 U	**1**	**1 J**	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	**3300**	**3100**	**3900**	**3700**	**1800**	**1600**	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	3 U	3 U	150 U	150 U	3 U	3 U	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	***10***	***10***	150 U	150 U	3 U	3 U	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	***6***	**5**	150 U	150 U	**3**	**3**	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	10 U	10 U	500 U	500 U	10 U	10 U	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	3 U	3 U	150 U	150 U	3 U	3 U	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	10 U	10 U	500 U	500 U	10 U	10 U	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	3 U	3 U	150 U	150 U	3 U	3 U	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	3 U	3 U	150 U	150 U	3 U	3 U	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	3 U	3 U	150 U	150 U	3 U	3 U	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon
Iowa Army Ammunition Plant, Middletown, IA

					Location	G-20											
					Sample ID	F04-GW-047	G-20-FBL	G-20-F01R1	G-20-F01R2	G-20-F01R3	G-20-F01R4	G-20-F01R5	G-20-F01R5-FD	G-20-F01R6	G-20-01R7	G-20-01R7-FD	G-20-F01R7
					Sample Depth (ft)	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5	9.5 - 19.5
					Sample Date	11/16/2004	3/20/2007	12/4/2007	1/10/2008	2/15/2008	3/17/2008	5/20/2008	5/20/2008	9/30/2008	3/4/2009	3/4/2009	3/5/2009
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**												
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**280000**	**257000**	**270000**	**240000**	**240000**	**260000**	**240000**	**270000**	**243000**	**274000**	**272000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**1000**	**349000**	**401000**	**314000**	**298000**	**286000**	**416000**	**508000**	**328000**	**267000**	**289000**	- -
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	**6400**	**5800**	**44100**	**35300**	**55100**	**6200**	**6700**	**5600**	**51900**	**55500**	- -
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**12000**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	***71000***	***94900***	***104000***	***125000***	***86500***	***84300***	3700 B	2500 U	***52400***	***70000***	***72500***	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	**500**	**220**	***2800***	***2700***	**670**	**740**	**290**	**270**	**210**	50 U	50 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**71000**	**67500**	**75100**	**72300**	**68200**	**68800**	**77500**	**77600**	**108000**	**70600**	**71400**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**24200**
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**13200**
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**11000**
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	**5040**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	***800 D***	***723***	**590**	***1090***	***1210***	***1070***	***1110***	***952***	***667***	***698***	***705***	- -
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**32**	**18.9**	**14.8**	**14.5**	**16.4**	**11.2**	**16**	**14.7**	**18.9**	**17.2**	**16.1**	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***12***	***9.6***	***6.6 J***	***28.1***	***33.8***	***30.1***	***29.7***	***26.6***	***9.6***	***12.7***	***12.6***	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	***140 D***	***3.9***	***65.2***	9.9 U	***2.3***	***6***	***8.2***	***8.6***	***7.9***	9.7 U	9.7 U	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***11:00 PM***	***12.9***	***9.6 J***	***12.6***	***12***	***8.7***	***8.1***	***7.8***	***5.7***	***11.3***	***10.9***	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***230 DP***	***32.9***	***46.2***	***40.4***	***36.1***	***34.4***	***33.8***	***31.8***	***22.8***	***27.4***	***28.1***	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.51 U	0.96 U	9.8 U	9.9 U	2 U	2 U	1.9 U	1.9 U	3.8 U	9.7 U	9.7 U	- -
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.51 U	0.96 U	9.8 U	9.9 U	2 U	2 U	1.9 U	1.9 U	3.8 U	9.7 U	9.7 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***22***	***16.4***	***20.8***	***20.8***	***20.1***	***19.1***	***17.4***	***19.1***	***13.5***	***17.4***	***17.4***	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.51 U	0.96 U	9.8 U	9.9 U	2 U	2 U	1.9 U	1.9 U	3.8 U	9.7 U	9.7 U	- -
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**34**	**42.9**	**26.1**	**24.5**	**21.2**	**21.1**	**18.3**	**13**	**16.7**	**11.4**	**12.9**	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	**13 P**	**11.7**	**7.1 J**	**7.2 J**	**6.3**	**7.1**	**6.7**	**5.4**	**6**	9.7 U	9.7 U	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	***1500 D***	**663**	**889**	***1160***	**887**	**754**	**800**	**654**	**906**	**914**	**832**	- -
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	***0.15 JP***	0.96 U	9.8 U	9.9 U	2 U	2 U	1.9 U	1.9 U	3.8 U	9.7 U	9.7 U	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***17000 D***	***2400***	***2070***	***4240***	***5830***	***4620***	***3300***	***2980***	***3790***	***7700***	***7130***	- -
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.51 U	0.96 U	9.8 U	9.9 U	2 U	2 U	1.9 U	1.9 U	3.8 U	9.7 U	9.7 U	- -
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	15 U	15 U	15 U	15 U	15 U	600 U	600 U	31.1 B	23 U	23 U	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	5 B	**16.8**	13.5 B	**20.1**	**18.5**	**21.5**	**23**	11.6 B	5 B	5.1 B	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	**72**	**3.2**	**52.8**	9.9 U	**7.2**	**7.1**	**5**	**5.4**	**5.7**	9.7 U	**2.9 J**	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	**2 J**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	**2900 D**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	***6.2***	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**0.67 J**	**0.77**	**0.22 J**	0.5 U	0.5 U	**0.15 J**	0.5 U	0.5 U	0.5 U	**0.24**	0.5 U	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-20				G-40					G-41	
					Sample ID	L800-G20-0818	G40-010700	G-40-053100	G-40-20001201	G-40-20010606	G-40-20020627	G-40-20040607	G-40-0518	G41-010600	G-41-053000	G-41-20001201
					Sample Depth (ft)	9.5 - 19.5	73.25 - 83.25	73.25 - 83.25	73.25 - 83.25	73.25 - 83.25	73.25 - 83.25	73.25 - 83.25	73.25 - 83.25	9.8 - 19.8	9.8 - 19.8	9.8 - 19.8
					Sample Date	8/28/2018	1/7/2000	5/31/2000	12/1/2000	6/6/2001	6/27/2002	6/7/2004	5/31/2018	1/6/2000	5/30/2000	12/1/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**											
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	- -	**207000**	- -	- -	- -	**470000**	**490000**	- -	**239000**	- -	**200000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	100 U	- -	- -	- -	**50**	**1300**	- -	290 U	- -	**50**
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	**183000**	- -	- -	- -	**210000**	**260000**	- -	**257000**	- -	**80000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	280 U	- -	- -	- -	1000 U	1000 U	- -	280 U	- -	1000 U
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	200 U	- -	- -	- -	1000 U	**5000**	- -	200 U	- -	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	100 U	- -	- -	- -	**500**	**12000**	- -	290 U	- -	**400**
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	- -	1200 U	- -	- -	- -	1000 U	**6100**	- -	620 U	- -	**3500**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	**2700**	- -	- -	- -	**2000**	**2000**	- -	**16400**	- -	**11000**
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	1600 U	- -	- -	- -	**320**	**120**	- -	50 U	- -	**90**
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	- -	**5100**	- -	- -	- -	**30000**	**25000**	- -	**35300**	- -	**30000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	**59 J**	0.03 U	0.16 U	0.69 U	0.78 U	0.47 U	0.49 U	**0.05 J**	0.03 U	0.16 U	1.4 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	0.2 UJ	- -	- -	- -	- -	- -	- -	0.11 UJ	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**19 J**	- -	- -	0.69 U	0.97 U	0.47 U	**29 J**	0.11 UJ	- -	- -	1.4 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	***12 J***	0.04 U	0.16 U	0.69 U	0.78 U	0.47 U	0.49 U	0.11 UJ	0.04 U	0.16 U	1.4 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	***4.5 J***	0.05 U	0.16 U	0.69 U	0.78 U	0.47 U	0.49 U	0.11 UJ	0.05 U	0.16 U	1.4 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	***2.8 J***	0.05 U	0.31 U	0.69 U	0.78 U	0.47 U	0.49 U	0.11 UJ	0.05 U	0.31 U	1.4 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	***16 J***	0.03 U	0.31 U	0.69 U	0.78 U	0.47 U	0.49 U	0.11 UJ	0.05 U	0.31 U	1.4 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.41 UJ	0.06 U	0.31 U	0.69 U	0.78 U	0.47 U	0.49 U	0.22 UJ	0.06 U	0.31 U	1.4 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	***7.8 J***	0.06 U	0.31 U	0.69 U	0.78 U	0.47 U	0.49 U	0.22 UJ	0.06 U	0.31 U	1.4 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	***7.9 J***	0.17 U	0.31 U	0.69 U	0.78 U	0.47 U	0.49 U	0.11 UJ	0.28 U	0.31 U	1.4 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.41 UJ	0.06 U	0.78 U	0.69 U	0.78 U	0.47 U	0.49 U	0.22 UJ	0.06 U	0.78 U	1.4 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**48 J**	- -	- -	- -	- -	- -	- -	0.22 UJ	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	**18 J**	- -	- -	- -	- -	- -	- -	0.11 UJ	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**620 J**	0.06 U	0.39 U	0.69 U	0.78 U	0.47 U	0.49 U	0.11 UJ	**1.6**	**1.3**	1.4 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 UJ	0.06 U	0.16 U	0.69 U	0.78 U	0.47 U	0.49 U	0.11 UJ	0.06 U	0.16 U	1.4 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***6500 J***	0.25 U	0.16 U	0.65 U	0.78 U	0.47 U	***8.8 J***	0.11 UJ	2.7 U	**2**	1.3 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 UJ	0.78 U	0.31 U	0.69 U	0.78 U	0.47 U	0.49 U	0.11 UJ	0.03 U	0.31 U	1.4 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	2.7 U	2.5 U	- -	10 U	- -	- -	- -	2.7 U	2.5 U	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	**226**	**267**	- -	**1440**	- -	- -	- -	**193**	**211**	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	0.04 U	0.3 U	- -	**1.1 J**	- -	- -	- -	0.64 U	0.3 U	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	**44800**	- -	- -	- -	- -	- -	- -	**75800**	- -	**60400**
METALS	7440-47-3	Chromium	μg/L	100	31	- -	**77.4**	**2.6 J**	- -	**5.6 J**	- -	- -	- -	**77.6**	2.5 U	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	**2.8**	**5.8**	- -	**3.3 J**	- -	- -	- -	1.4 U	**3.6 J**	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	**22700**	- -	- -	- -	- -	- -	- -	**27800**	- -	**20500**
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	0.06 U	0.1 U	- -	0.21 U	- -	- -	- -	0.06 U	0.1 U	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	3.2 U	**3.4 J**	- -	**3.4 J**	- -	- -	- -	3.3 U	2 U	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	1.1 U	0.5 U	- -	10 U	- -	- -	- -	1.1 U	0.5 U	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	**45600**	- -	- -	- -	- -	- -	- -	**7100**	- -	**5260**
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	- -	0.02 U	0.16 U	0.69 U	0.78 U	0.47 U	0.49 U	- -	0.02 U	0.16 U	1.4 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	3 U	- -	- -	- -	0.11 U	0.5 U	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	3 U	- -	- -	- -	0.31 U	0.5 U	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	3 U	- -	- -	- -	**1.2 J**	**1**	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -	0.51 U	0.5 U	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	0.14 U	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	10 U	- -	- -	- -	0.7 U	2 U	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	3 U	- -	- -	- -	0.51 U	0.5 U	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	10 U	- -	- -	- -	0.69 U	2 U	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -	0.82 U	0.5 U	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	3 U	- -	- -	- -	0.3 U	0.5 U	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -	0.61 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-41				G-42					
					Sample ID	G-41-20010617	G-41-20020626	G-41-20040606	G-41-FBL	G42-011100	G-42-053000	G-42-20001121	G-42-20010619	G-42-20020613	G-42-20040607
					Sample Depth (ft)	9.8 - 19.8	9.8 - 19.8	9.8 - 19.8	9.8 - 19.8	66.5 - 76.5	66.5 - 76.5	66.5 - 76.5	66.5 - 76.5	66.5 - 76.5	66.5 - 76.5
					Sample Date	6/17/2001	6/26/2002	6/6/2004	3/19/2007	1/11/2000	5/30/2000	11/21/2000	6/19/2001	6/13/2002	6/7/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**230000**	**240000**	**240000**	**238000**	**443000**	- -	**400000**	**430000**	**430000**	**420000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**210**	**220**	**360**	- -	730 U	- -	**190**	**230**	**270**	**310**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**200000**	**110000**	**85000**	**337000**	**400000**	- -	**42000**	**100000**	**190000**	**70000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	- -	240 U	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	- -	**1400**	- -	1000 U	1000 U	**19000**	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**600**	**1000**	1000 U	- -	290 U	- -	**500**	**500**	300 U	1000 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**3000**	**3200**	**3800**	**4300**	620 U	- -	**1000**	1000 U	**1700**	**1100**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**18000**	**15000**	**7000**	- -	**1500**	- -	1000 U	1000 U	1000 U	1000 U
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	50 U	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**80**	10 U	50 U	- -	**740**	- -	**30**	**80**	100 U	50 U
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	50 U	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**82000**	**39000**	**37000**	**38400**	**5400**	- -	**12000**	**7000**	**9000**	**7000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.92 U	1.1 U	0.49 U	0.19 U	0.03 U	0.19 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.2 U	1.1 U	0.49 U	0.19 U	- -	- -	0.6 U	1.1 U	0.99 U	0.49 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.92 U	1.1 U	0.49 U	0.19 U	0.04 U	0.19 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.92 U	1.1 U	0.49 U	0.19 U	0.05 U	0.19 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.92 U	1.1 U	0.49 U	0.19 U	0.05 U	0.39 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.92 U	1.1 U	0.49 U	0.19 U	0.03 U	0.39 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.92 U	1.1 U	0.49 U	0.19 U	0.06 U	0.39 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.92 U	1.1 U	0.49 U	0.19 U	0.09 U	0.39 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.92 U	1.1 U	0.49 U	0.19 U	0.02 U	0.39 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.92 U	1.1 U	0.49 U	0.19 U	0.06 U	0.97 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	0.19 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	0.19 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.92 U	1.1 U	0.49 U	0.19 U	0.06 U	**0.49**	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.92 U	1.1 U	0.49 U	0.19 U	0.06 U	0.19 U	0.6 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.92 U	1.1 U	0.49 U	0.19 U	0.05 U	0.19 U	0.56 U	0.87 U	0.79 U	0.49 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.92 U	1.1 U	0.49 U	0.19 U	0.03 U	0.39 U	0.6 U	0.87 U	0.79 U	0.49 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	**5.2 J**	- -	- -	- -	2.7 U	2.5 U	- -	10 U	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**180 J**	- -	- -	- -	**264**	**232**	- -	**249**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	- -	- -	- -	0.64 U	0.3 U	- -	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**68500**	- -	- -	- -	**78600**	- -	**82900**	**78200**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	- -	- -	- -	**5.9**	**9.5 J**	- -	**0.6 J**	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	**4770**	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	- -	- -	- -	1.4 U	**3.4 J**	- -	**3.2 J**	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**25000**	- -	- -	- -	**45800**	- -	**49400**	**46900**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	**174**	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	- -	- -	- -	0.06 U	0.1 U	- -	0.21 U	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	**2.5 J**	- -	- -	- -	2.9 U	2 U	- -	10 U	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	- -	- -	- -	1.1 U	0.5 U	- -	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**7990**	- -	- -	- -	**20000**	- -	**18000**	**17300**	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.92 U	1.1 U	0.49 U	0.19 U	0.02 U	0.19 U	0.6 U	0.87 U	0.79 U	0.49 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	5 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	**3**	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	10 U	- -	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	3 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	**0.89**	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	10 U	- -	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	3 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-43							G-44		
					Sample ID	G43-010300	G-43-053000	G-43-20001121	G-43-20010619	G-43-20020626	G-43-20040607	L800-G-43-0818	G44-010300	G-44-053100	G-44-20001122
					Sample Depth (ft)	32.1 - 42.1	32.1 - 42.1	32.1 - 42.1	32.1 - 42.1	32.1 - 42.1	32.1 - 42.1	32.1 - 42.1	68 - 78	68 - 78	68 - 78
					Sample Date	1/3/2000	5/30/2000	11/21/2000	6/19/2001	6/26/2002	6/7/2004	8/29/2018	1/3/2000	5/31/2000	11/22/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**313000**	- -	**290000**	**320000**	**300000**	**290000**	- -	**220000**	- -	**60000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	100 U	- -	**180**	**160**	**190**	**70**	- -	**440**	- -	**90**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**305000**	- -	**30000**	**48000**	**130000**	**140000**	- -	**171000**	- -	100 U
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	**410**	- -	1000 U	1000 U	1000 U	1000 U	- -	**540**	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	200 U	- -	1000 U	1000 U	1000 U	1000 U	- -	**2100**	- -	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	100 U	- -	**600**	**300**	300 U	1000 U	- -	100 U	- -	**300**
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	620 U	- -	1000 U	1000 U	1000 U	1000 U	- -	620 U	- -	**1400**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**2400**	- -	**2000**	**2000**	**3000**	**3000**	- -	**7200**	- -	**6000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	- -	**20**	**100**	**120**	**60**	- -	**1100**	- -	**940**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**7100**	- -	**6100**	**6000**	**7000**	**7000**	- -	**21100**	- -	**16000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.03 U	0.16 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.03 U	0.19 U	1 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	0.11 UJ	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	0.97 U	0.53 U	0.79 U	0.49 U	0.11 UJ	- -	- -	1 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.04 U	0.16 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.04 U	0.19 U	1 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.05 U	0.16 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.05 U	0.19 U	1 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.05 U	0.31 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.05 U	0.39 U	1 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.03 U	0.31 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.03 U	0.39 U	1 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.06 U	0.31 U	0.97 U	0.43 U	0.79 U	0.51 U	0.21 UJ	0.06 U	0.39 U	1 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.25 U	0.31 U	0.97 U	0.43 U	0.79 U	0.49 U	0.21 UJ	0.38 U	0.39 U	1 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.02 U	0.31 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.02 U	0.39 U	1 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.06 U	0.78 U	0.97 U	0.43 U	0.79 U	0.49 U	0.21 UJ	0.06 U	0.97 U	1 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.21 UJ	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	0.11 UJ	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.1 U	0.39 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.06 U	0.49 U	1 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.06 U	0.16 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.06 U	0.19 U	1 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.14 U	0.16 U	0.92 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.05 U	0.19 U	0.95 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.06 U	0.31 U	0.97 U	0.43 U	0.79 U	0.49 U	0.11 UJ	0.03 U	0.39 U	1 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	**5.7**	**5.8 J**	- -	**9.3 J**	- -	- -	- -	2.7 U	2.5 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**508**	**512**	- -	**522**	- -	- -	- -	**423**	**343**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	0.64 U	0.3 U	- -	5 U	- -	- -	- -	0.64 U	0.3 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**83400**	- -	**83400**	**77100**	- -	- -	- -	**52700**	- -	**37900**
METALS	7440-47-3	Chromium	µg/L	100	31	**1.4**	**8.2 J**	- -	**1.5 J**	- -	- -	- -	**36**	**4.3 J**	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	1.4 U	**3.4 J**	- -	**2.6 J**	- -	- -	- -	1.4 U	1.7 U	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**23600**	- -	**23800**	**24000**	- -	- -	- -	**7500**	- -	**4940 J**
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.06 U	0.1 U	- -	0.21 U	- -	- -	- -	0.06 U	0.1 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	2.9 U	**2.6 J**	- -	10 U	- -	- -	- -	2.9 U	**3.3 J**	- -
METALS	7440-22-4	Silver	µg/L	130	10	1.9 U	0.5 U	- -	10 U	- -	- -	- -	1.1 U	0.5 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**14500**	- -	**11200**	**12200**	- -	- -	- -	**24700**	- -	**20100**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.02 U	0.16 U	0.97 U	0.43 U	0.79 U	0.49 U	- -	0.02 U	0.19 U	1 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-44				G-45					
					Sample ID	G-44-20010619	G-44-20020630	G-44-20040617	S08-G-44-GW-REG	G45-010300	G-45-053100	G-45-20001122	G-45-20010619	G-45-20020630	G-45-20040617
					Sample Depth (ft)	68 - 78	68 - 78	68 - 78	68 - 78	30 - 40	30 - 40	30 - 40	30 - 40	30 - 40	30 - 40
					Sample Date	6/19/2001	6/30/2002	6/17/2004	5/7/2008	1/3/2000	5/31/2000	11/22/2000	6/19/2001	6/30/2002	6/17/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**360000**	**300000**	**80000**	- -	**279000**	- -	**260000**	**260000**	**270000**	**250000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**340**	**430**	**330 J**	- -	100 U	- -	**100**	**120**	**110**	40 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**1800**	**130000**	- -	- -	**270000**	- -	**22000**	**60000**	**120000**	**42000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	- -	**70**	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	**260**	1000 U	- -	200 U	- -	**1400**	1000 U	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	**800**	**600**	1000 U	- -	100 U	- -	**400**	300 U	300 U	1000 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1000**	**1700**	**1000**	- -	620 U	- -	**1000**	1000 U	**2200**	1000 U
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**3000**	**2000**	**7000**	- -	**14800**	- -	**14000**	**16000**	**17000**	**16000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**300**	**450**	**1100**	- -	50 U	- -	10 U	**20**	10 U	50 U
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**10000**	**11000**	**15000**	- -	**22300**	- -	**23000**	**24000**	**28000**	**27000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.6 U	0.55 U	0.48 U	- -	0.03 U	0.19 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.9 U	0.55 U	0.48 U	- -	- -	- -	1.2 U	0.97 U	0.78 U	0.48 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.6 U	0.55 U	0.48 U	- -	0.04 U	0.19 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.6 U	0.55 U	0.48 U	- -	0.05 U	0.19 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	1.6 U	0.55 U	0.48 U	- -	0.05 U	0.39 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	1.6 U	0.55 U	0.48 U	- -	0.03 U	0.39 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	1.6 U	0.55 U	0.48 U	- -	0.06 U	0.39 U	1.2 U	0.78 U	0.78 U	1.8 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	1.6 U	0.55 U	0.48 U	- -	0.19 U	0.39 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	1.6 U	0.55 U	0.48 U	- -	0.02 U	0.39 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	1.6 U	0.55 U	0.48 U	- -	0.06 U	0.97 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.6 U	0.55 U	0.48 U	- -	0.33 U	0.49 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	1.6 U	0.55 U	0.48 U	- -	0.06 U	0.19 U	1.2 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.6 U	0.55 U	0.48 U	- -	0.05 U	0.19 U	1.1 U	0.78 U	0.78 U	0.48 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.6 U	0.55 U	0.48 U	- -	0.24 U	0.39 U	1.2 U	0.78 U	0.78 U	0.48 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	**3.8 J**	- -	- -	- -	**4.1**	2.5 U	- -	10 U	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**1590**	- -	- -	- -	**840**	**774**	- -	**860**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	- -	- -	- -	**3.3**	0.3 U	- -	**0.3 J**	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**57100**	- -	- -	- -	**86400**	- -	**76800**	**82000**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	**3.9 J**	- -	- -	- -	1.2 U	2.5 U	- -	**0.3 J**	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	**2.2 J**	- -	- -	- -	1.4 U	1.7 U	- -	**2.9 J**	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**30700**	- -	- -	- -	**23200**	- -	**20200**	**22200**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	- -	- -	- -	0.06 U	0.1 U	- -	0.21 U	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	10 U	- -	- -	- -	2.9 U	2 U	- -	10 U	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	- -	- -	- -	5.1 U	0.5 U	- -	**0.3 J**	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**30300**	- -	- -	- -	**14300**	- -	**9900**	**11300**	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	1.6 U	0.55 U	0.48 U	- -	0.35 U	0.19 U	1.2 U	0.78 U	0.78 U	0.48 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	- -	- -	- -	- -	- -	- -	3 U	3 U	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	3 U	- -	- -	- -	- -	- -	- -	3 U	**6**	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	- -	- -	- -	- -	- -	- -	3 U	3 U	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	- -	- -	- -	- -	- -	- -	3 U	3 U	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	3 U	3 U	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	10 U	- -	- -	- -	- -	- -	- -	10 U	10 U	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	3 U	- -	- -	- -	- -	- -	- -	3 U	3 U	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	10 U	- -	- -	- -	- -	- -	- -	10 U	10 U	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	3 U	3 U	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	**137 J**	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	3 U	- -	- -	- -	- -	- -	- -	3 U	3 U	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	3 U	3 U	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-45			G-46					G-47	
					Sample ID	G-45-0818	G-46-053100	G-46-20001128	G-46-20010607	G-46-20020630	G-46-20040606	G-47-053100	G-47-20001127	G-47-20010606	G-47-20020629
					Sample Depth (ft)	30 - 40	58 - 68	58 - 68	58 - 68	58 - 68	58 - 68	16 - 26	16 - 26	16 - 26	16 - 26
					Sample Date	8/27/2018	5/31/2000	11/28/2000	6/7/2001	6/30/2002	6/6/2004	5/31/2000	11/27/2000	6/6/2001	6/29/2002
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	**490000**	**390000**	- -	**250000**	**190000**	**220000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	**60**	**40**	- -	10 U	10 U	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	**220000**	**26000**	- -	**38000**	**90000**	**97000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	1000 U	1000 U	- -	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	1000 U	1000 U	- -	**1000**	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	**1000**	1000 U	- -	300 U	300 U	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	**1700**	1000 U	- -	1000 U	1000 U	1000 U
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	**1000**	**4000**	- -	**46000**	**34000**	**48000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	**150**	**260**	- -	**5700**	**4000**	**3300**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	**60000**	**50000**	- -	**40000**	**27000**	**30000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.1 U	0.16 U	0.91 U	0.81 U	0.66 U	0.5 U	0.16 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	0.1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.1 U	- -	0.91 U	1 U	0.66 U	0.5 U	- -	0.38 U	1 U	0.88 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.1 U	0.16 U	0.91 U	0.81 U	0.66 U	0.5 U	0.16 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.1 U	0.16 U	0.91 U	0.81 U	0.66 U	0.5 U	0.16 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.1 U	0.31 U	0.91 U	0.81 U	0.66 U	0.5 U	0.31 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.1 U	0.31 U	0.91 U	0.81 U	0.66 U	0.5 U	0.31 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.21 U	0.31 U	0.91 U	0.81 U	0.66 U	2.7 U	0.31 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.21 U	0.31 U	0.91 U	0.81 U	0.66 U	0.5 U	0.31 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.1 U	0.31 U	0.91 U	0.81 U	0.66 U	0.5 U	0.31 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.21 U	0.78 U	0.91 U	0.81 U	0.66 U	0.5 U	0.78 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.21 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.1 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.1 U	0.39 U	0.91 U	0.81 U	0.66 U	0.5 U	0.39 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.1 U	0.16 U	0.91 U	0.81 U	0.66 U	0.5 U	0.16 U	0.38 U	0.81 U	0.88 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.1 U	0.16 U	0.85 U	0.81 U	0.66 U	0.5 U	**0.27**	**0.62**	0.81 U	0.88 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.1 U	0.31 U	0.91 U	0.81 U	0.66 U	0.5 U	0.31 U	0.38 U	0.81 U	0.88 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	**6.3 J**	- -	**4.4 J**	- -	20 U	**2.5 J**	- -	10 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**546**	- -	**1140**	- -	**166 J**	**117**	- -	**96.5 J**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	**0.7 J**	- -	5 U	- -	5 U	0.3 U	- -	5 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	**84700**	**69500**	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	**66.9**	- -	**13.2**	- -	**6.7 J**	**7.8 J**	- -	**0.5 J**	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	***29.8***	- -	**7.1 J**	- -	10 U	**2.5 J**	- -	**2.1 J**	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	**30100**	**25900**	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.1 U	- -	0.21 U	- -	0.2 U	0.1 U	- -	0.21 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	**7.6**	- -	**3.1 J**	- -	**3.5 J**	**3.3 J**	- -	**2.6 J**	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	0.5 U	- -	10 U	- -	10 U	0.5 U	- -	10 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	**10300**	**10400**	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	- -	0.16 U	0.91 U	0.81 U	0.66 U	0.5 U	0.16 U	0.38 U	0.81 U	0.88 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	3 U	3 U	- -	- -	- -	- -	3 U	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	3 U	3 U	- -	- -	- -	- -	3 U	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	3 U	3 U	- -	- -	- -	- -	3 U	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	3 U	3 U	- -	- -	- -	- -	3 U	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	3 U	3 U	- -	- -	- -	- -	3 U	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	10 U	10 U	- -	- -	- -	- -	10 U	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	3 U	3 U	- -	- -	- -	- -	3 U	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	10 U	10 U	- -	- -	- -	- -	10 U	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	**2 J**	**2 J**	- -	- -	- -	- -	3 U	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	3 U	3 U	- -	- -	- -	- -	3 U	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	3 U	3 U	- -	- -	- -	- -	3 U	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-47			G-48						
					Sample ID	G-47-20040606	G-47-FBL	G47-0418	D012 (G48 DUP)	G48-010700	G-48-052400	G-48-20001127	G-48-20010613	G-48-20020625	G-48-20040605
					Sample Depth (ft)	16 - 26	16 - 26	16 - 26	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30
					Sample Date	6/6/2004	3/20/2007	4/24/2018	1/7/2000	1/7/2000	5/24/2000	11/27/2000	6/13/2001	6/25/2002	6/5/2004
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[(1)])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**240000**	**255000**	- -	**416000**	**413000**	- -	**400000**	**390000**	**380000**	**350000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**110**	- -	- -	100 U	100 U	- -	10 U	20 U	10 U	40 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**170000**	**338000**	- -	**408000**	**331000**	- -	**190000**	**450000**	**170000**	**140000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	- -	- -	270 U	260 U	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	- -	- -	200 U	200 U	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	1000 U	- -	- -	100 U	290 U	- -	300 U	300 U	300 U	1000 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	**6400**	- -	620 U	620 U	- -	1000 U	1000 U	1000 U	1000 U
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**75000**	- -	- -	**1600**	**10200**	- -	1000 U	1000 U	1000 U	**1000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	**3700**	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	**860**	- -	- -	5000 U	50 U	- -	50 U	**140**	**80**	**140**
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	50 U	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**32000**	**35900**	- -	**21300**	**27300**	- -	**29000**	**25000**	**22000**	**28000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.51 U	0.19 U	0.42 U	0.03 U	0.03 U	0.16 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	0.21 UJ	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.51 U	**0.11 J**	- -	- -	- -	- -	0.68 U	0.55 U	0.39 U	0.49 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.51 U	0.19 U	0.21 UJ	0.04 U	0.04 U	0.16 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.51 U	0.19 U	0.21 UJ	0.05 U	0.05 U	0.16 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.51 U	0.19 U	0.21 UJ	0.05 U	0.05 U	0.31 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.51 U	0.19 U	0.12 UJ	0.03 U	0.03 U	0.31 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	2.2 U	0.19 U	0.21 UJ	0.06 U	0.06 U	0.31 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.51 U	0.19 U	0.21 UJ	0.06 U	0.06 U	0.31 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.51 U	0.19 U	0.12 UJ	0.02 U	0.11 U	0.31 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.51 U	0.19 U	**0.25 J**	0.06 U	0.06 U	0.78 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	0.19 U	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.19 U	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.51 U	0.19 U	0.21 U	0.06 U	0.06 U	0.39 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.51 U	0.19 U	0.21 UJ	0.06 U	0.06 U	0.16 U	0.68 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	**1.4**	***3.1***	**1.2**	0.05 U	0.22 U	0.16 U	0.63 U	0.44 U	0.39 U	0.49 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.51 U	0.19 U	0.21 U	0.03 U	0.03 U	0.31 U	0.68 U	0.44 U	0.39 U	0.49 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	2.7 U	2.7 U	2.4 U	- -	10 U	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	**140**	**146**	**135**	- -	**122 J**	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	0.64 U	0.64 U	0.4 U	- -	5 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	**107000**	**111000**	- -	**98300**	**88900**	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	1.2 U	1.2 U	1.8 U	- -	**0.8 J**	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	15 U	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	**1.6**	1.4 U	1.7 U	- -	**5.8 J**	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	**35500**	**36600**	- -	**32200**	**28600**	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	1.5 U	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	0.06 U	0.06 U	0.1 U	- -	0.21 U	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	3.3 U	2.9 U	2.6 U	- -	**4.6 J**	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	1.1 U	1.1 U	2.8 U	- -	10 U	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	**22300**	**24000**	- -	**20100**	**29000**	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.51 U	0.19 U	- -	0.02 U	0.02 U	0.16 U	0.68 U	0.44 U	0.39 U	0.49 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	0.5 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	3 U	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location					G-56						
					Sample ID	G56-011800	G-56-051900	G-56-20001024	G-56-20010615	G-56-20020614	G-56-20040615	F04-GW-017	G-56-FBL	G-56-F01R1	G-56-F01R2	G-56-F01R3
					Sample Depth (ft)	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51
					Sample Date	1/18/2000	5/19/2000	10/24/2000	6/15/2001	6/14/2002	6/15/2004	11/11/2004	3/20/2007	12/7/2007	1/14/2008	2/21/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**											
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**317000**	- -	**300000**	**330000**	**330000**	**290000**	**300000**	**275000**	**268000**	**268000**	**303000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	290 U	- -	**20**	**280**	**160**	40 U	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**295000**	- -	**44000**	**160000**	**150000**	**160000**	**5500**	**331000**	**464000**	**271000**	**327000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	270 U	- -	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	**500**	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	**1500**	- -	**400**	**500**	**400**	1000 U	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	620 U	- -	**1400**	**1100**	**1400**	**1300**	**1200**	**3000**	**9100**	**25800**	**47500**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	**3000**	- -	**2700**	**2000**	**2000**	**2000**	**2000**	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	**700**	**2800**	**4900**	**3300**	**2300**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	**2300**	- -	**2100**	**1100**	**550**	**50**	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	- -	- -	- -	100 U	50 U	***2200***	***1500***	50 U
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**28800**	- -	**29000**	**25000**	**30000**	**28000**	**30000**	**32400**	**31300**	**33800**	**31800**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.03 U	0.16 U	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	- -	- -	**1.9 J**	**3.2**	**1.3 J**	**1.8**	**1.7**	**1.6**	**1.9**	**1.6**	**1.4**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.04 U	0.16 U	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.18 U	0.16 U	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.05 U	0.31 U	***0.36 J***	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.03 U	0.31 U	0.42 U	1.2 U	0.48 U	0.48 U	**0.36 JP**	**0.24**	**0.34**	**0.26**	**0.17 J**
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.06 U	0.31 U	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.06 U	0.31 U	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**1.4**	0.31 U	**1.4 J**	1.2 U	0.48 U	**1**	**1.2**	**1.1**	**1.4**	**1.1**	**0.81**
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.06 U	***8.5***	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	**0.25 J**	**0.33**	**0.33**	**0.33**	**0.15 J**
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	**0.26 JP**	**0.18 J**	**0.18 J**	**0.23**	**0.12 J**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	4.4 U	**6.6**	**5.4 J**	**3.9**	**4.6 J**	**9**	**9.2**	**7.9**	**9.3**	**7.7**	**5.9**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.06 U	0.16 U	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***140***	***120***	***99 J***	***84***	***77***	***89***	***85 D***	***85.3***	***102***	***84.1***	***65.4***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	3.4 U	0.31 U	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	**10.7**	**4.7 J**	- -	10 U	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	**331**	**197**	- -	**1190**	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	**0.8**	0.3 U	- -	5 U	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	**86400**	- -	**81300**	**85300**	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	**8.6**	**22**	- -	**0.4 J**	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	**606**	79 B	15 U	15 U
METALS	7439-92-1	Lead	μg/L	15	18.05	**5.8**	**5.2**	- -	10 U	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	**30000**	- -	**25300**	**28400**	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	**327**	**442**	**55.3**	***572***
METALS	7439-97-6	Mercury	μg/L	2	1	0.06 U	0.1 U	- -	0.21 U	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	2.9 U	2 U	- -	**2.6 J**	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	1.1 U	0.5 U	- -	10 U	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	**16400**	- -	**13800**	**18900**	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.02 U	0.16 U	0.42 U	1.2 U	0.48 U	0.48 U	0.49 U	0.19 U	0.2 U	0.2 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	**8**	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	**1.4**	**0.3 J**	**0.57**	0.5 U	0.5 U
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	3 U	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-56									G-57	
					Sample ID	G-56-F01R3-FD	G-56-F01R4	G-56-F01R4A	G-56-F01R5	G-56-F01R6	G-56-01R7	G-56-F01R7	G-56-F01R9	L800-G56-0818	G57-010700	G-57-052400
					Sample Depth (ft)	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	18.5 - 28.51	19.95 - 29.96	19.95 - 29.96
					Sample Date	2/21/2008	3/17/2008	3/27/2008	5/21/2008	9/30/2008	3/5/2009	3/6/2009	8/26/2009	8/20/2018	1/7/2000	5/24/2000
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])											
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**300000**	**300000**	**293000**	**623000**	**251000**	**1420000**	- -	- -	- -	**275000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	290 U	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**327000**	**324000**	**327000**	**791000**	**262000**	**5770000**	- -	- -	- -	**268000**	- -
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	390 U	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	200 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	100 U	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**45000**	**54500**	- -	**1300**	**2300**	**1980000**	- -	**31200**	- -	620 U	- -
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	**6600**	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**2300**	- -	**1500**	**2200**	**1100**	2500 U	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	***60900***	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	- -	70 B	50 U	50 U	***3000***	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**31800**	**31600**	**32300**	**31700**	**29800**	**11700**	- -	- -	- -	**34900**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	**45500000**	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	**15100000**	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	**4320000**	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	**623000**	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.1 U	0.03 U	0.16 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	0.1 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**1.7**	**1.3**	- -	**1.8**	**1.6**	1.5 U	- -	0.19 U	0.1 U	- -	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.1 U	0.04 U	0.16 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.1 U	0.37 U	0.16 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.1 U	0.05 U	0.31 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	**0.17 J**	**0.12 J**	- -	**0.081 J**	0.19 U	0.77 U	- -	0.19 U	0.1 U	0.03 U	0.31 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.21 U	0.06 U	0.31 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.21 U	0.06 U	0.31 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**0.83**	**0.51**	- -	**0.7**	**0.29**	0.77 U	- -	0.19 U	0.1 U	0.55 U	**0.52 J**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.21 U	0.06 U	0.78 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**0.25**	0.2 U	- -	**0.15 J**	**0.18 J**	0.77 U	- -	0.19 U	0.21 U	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	**0.24**	**0.11 J**	- -	**0.15 J**	**0.21**	1.5 U	- -	0.19 U	0.1 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**7**	**5.6**	- -	**6.8**	**7**	1.5 U	- -	0.19 U	**0.24**	12 U	**24 J**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.1 U	0.06 U	0.16 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***80.3***	***57.1***	- -	***72.9***	***55.1***	**1.9**	- -	0.19 U	**0.36**	***780***	***580 J***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	0.1 U	0.03 U	0.31 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.7 U	2.4 U
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -	- -	**408**	**379**
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.64 U	0.4 U
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	**125000**	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -	- -	**14.5**	**9.6 J**
METALS	7439-89-6	Iron	µg/L	14000	9736	15 U	15 U	- -	15 U	57.1 B	***166000***	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.4 U	1.7 U
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	**42800**	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	***759***	**380**	- -	**121**	**334**	***32600***	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.06 U	0.1 U
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.4 U	2.6 U
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.1 U	2.8 U
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	**29200**	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.2 U	- -	0.19 U	0.19 U	0.77 U	- -	0.19 U	- -	0.02 U	0.16 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	0.5 U	**0.17 J**	- -	**1.38**	**124**	**185**	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-57							G-58		
					Sample ID	G-57-20001129	G-57-20010617	G-57-20020629	G-57-20040615	G-57-FBL	L800-G57-F01R6	G-57-01R7	G58-010700	G-58-052400	G-58-20001129
					Sample Depth (ft)	19.95 - 29.96	19.95 - 29.96	19.95 - 29.96	19.95 - 29.96	19.95 - 29.96	19.95 - 29.96	19.95 - 29.96	20 - 30	20 - 30	20 - 30
					Sample Date	11/29/2000	6/17/2001	6/29/2002	6/15/2004	3/20/2007	9/28/2008	3/5/2009	1/7/2000	5/24/2000	11/29/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**										
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**280000**	**270000**	**210000**	**260000**	**238000**	**528000**	**1420000**	**326000**	- -	**290000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	10 U	10 U	40 U	- -	- -	- -	**1000**	- -	**240**
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**50000**	**140000**	**92000**	**165000**	**278000**	**510000**	**4370000**	**347000**	- -	**170000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	450 U	- -	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	200 U	- -	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	300 U	1000 U	- -	- -	- -	290 U	- -	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**2000**	**1900**	**2700**	**1900**	**2100**	**2600**	**1570000**	5100 U	- -	**3700**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**6300**	**6000**	**23000**	**7000**	- -	- -	- -	**6800**	- -	**9900**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	***37600***	50 U	2500 U	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	***47000***	***42000***	***43000***	***48000***	- -	- -	- -	***16600***	- -	***14000***
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	50 U	50 U	***2900***	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**42000**	**36000**	**32000**	**43000**	**37700**	**10700**	**2700**	**30200**	- -	**49000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	0.03 U	0.16 U	0.71 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**6.8**	**13 J**	**6.6**	**8.8**	**6.4**	**0.61**	0.78 U	- -	- -	**14**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	0.04 U	0.16 U	0.71 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	***8.1***	0.16 U	0.71 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.46 U	***0.65 J***	***0.47 J***	***0.27 J***	***0.21***	0.19 U	0.78 U	0.05 U	0.31 U	***6.1***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	***3.7***	***3.2 J***	***2.7***
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	0.11 U	0.31 U	0.71 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	0.06 U	0.31 U	0.71 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**0.54**	**0.91 J**	**0.75**	**0.51 J**	**0.51**	0.19 U	0.78 U	***7.2***	***10 J***	***9.1***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	0.06 U	0.78 U	0.71 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	- -	**2.6**	0.19 U	0.78 U	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	**0.95**	0.19 U	0.78 U	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**16**	**28**	**21**	**23**	**18.8**	0.19 U	0.78 U	**250**	**280 J**	**220**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	0.06 U	0.16 U	0.71 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***580***	***830***	***710***	***700***	***606***	0.19 U	0.78 U	***1200***	***2600 J***	***2000***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	0.03 U	0.31 U	0.71 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	**3.8 J**	- -	- -	- -	- -	- -	2.7 U	2.4 U	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	**364**	- -	- -	- -	- -	- -	**231**	**239**	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	**0.3 J**	- -	- -	- -	- -	- -	0.64 U	0.4 U	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**114000**	**102000**	- -	- -	- -	- -	- -	**102000**	- -	**83800**
METALS	7440-47-3	Chromium	µg/L	100	31	- -	10 U	- -	- -	- -	- -	- -	**5.4**	**3.2 J**	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	15 U	***33700***	***380000***	- -	- -	- -
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	10 U	- -	- -	- -	- -	- -	**1.9**	**2.1 J**	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**37700**	**36900**	- -	- -	- -	- -	- -	**26200**	- -	**24900**
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	- -	**254**	***6840***	***15000***	- -	- -	- -
METALS	7439-97-6	Mercury	µg/L	2	1	- -	0.21 U	- -	- -	- -	- -	- -	0.06 U	0.1 U	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	10 U	- -	- -	- -	- -	- -	2.9 U	**2.8 J**	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	10 U	- -	- -	- -	- -	- -	1.1 U	2.8 U	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**22900**	**24500**	- -	- -	- -	- -	- -	**45300**	- -	**35100**
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.46 U	1.3 U	0.64 U	0.48 U	0.2 U	0.19 U	0.78 U	**1.4**	**2.1 J**	**1.9**
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	3 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	6 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	3 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	3 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	10 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	3 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	0.5 U	**12800**	**10300**	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	10 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	3 U	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	3 U	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	G-58-20010617	G-58-20020628	G-58-20040616	G-58-FBL	G-58-F01R1	G-58-F01R2	G-58-F01R3	G-58-F01R3-FD	G-58-F01R4	G-58-F01R5	G-58-F01R6	G-58-01R7
					Location	G-58											
					Sample Depth (ft)	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30
					Sample Date	6/17/2001	6/28/2002	6/16/2004	3/21/2007	12/10/2007	1/15/2008	2/20/2008	2/20/2008	3/19/2008	5/20/2008	9/30/2008	3/3/2009
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**310000**	**300000**	**260000**	**220000**	**258000**	**228000**	**220000**	**235000**	**400000**	**435000**	**192000**	**281000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	**290**	**230**	**110**	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**600000**	**130000**	**460000**	**323000**	**517000**	**271000**	**357000**	**345000**	**453000**	**1200000**	**406000**	**354000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	4 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	36000 U	1000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	1000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**3700**	**3500**	**2800**	**7800**	**1900**	**6100**	**49700**	**46700**	**48800**	**2700**	**2100**	**63700**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**9000**	**9000**	**8000**	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	***68100***	***36900***	***40500***	***62300***	***60200***	***66600***	***66700***	***56600***	***27800***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	***25000***	***23000***	***56000***	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	50 U	***2600***	***1500***	50 U	50 U	50 U	50 U	50 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**41000**	**40000**	**36000**	**33800**	**27800**	**28300**	**30800**	**31200**	**32800**	**33800**	**28000**	**19200**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.51 U	0.53 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**21 J**	**12**	**15 J**	**9.5**	**7.9**	**8.3**	**6.3**	**10.6**	**10.3**	**11.1**	**7.1**	**8.1**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.51 U	0.53 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.51 U	0.53 U	0.48 U	**0.098 J**	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	**0.066 J**	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***7.8***	***9.4***	***4.7***	***2.5***	***0.95***	***0.89***	***1.5***	***1.5***	***1.8***	***2.1***	***1.5***	***0.22***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***3.5***	0.53 U	***2.4 J***	**1.6**	**0.88**	**0.98**	**1.2**	**1.2**	**1.3**	**1.6**	**1.3**	**0.38**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.51 U	0.53 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.51 U	0.53 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***11***	0.53 U	***6.8 J***	***4.1***	***2.1***	***2.4***	***3.1***	***3.3***	***3.7***	***4.2***	***2.9***	**1.1**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.51 U	0.53 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	- -	- -	- -	**1**	**0.82**	**0.82**	**0.68**	**0.53**	**1.6**	**0.99**	**0.61**	0.38 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	**1.5**	**0.96**	**1**	**0.64**	**1.1**	**1.2**	**1.1**	**0.96**	**0.86**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**290**	**250**	**230**	**124**	**81.1**	**90.2**	**67.8**	**114**	**131**	**112**	**105**	**62.6**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.51 U	0.53 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***2200***	***2000***	***2100***	***1330***	***840***	***975***	***850***	***1290***	***1430***	***1230***	***1050***	***610***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.51 U	0.53 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	**245**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	**88900**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	15 U	15 U	15 U	600 U	600 U	15 U	15 U	23 U	23 U
METALS	7439-92-1	Lead	µg/L	15	18.05	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	**30900**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	- -	***1820***	***2200***	***1510***	***1000***	***770***	**576**	***1330***	***1280***	**326**
METALS	7439-97-6	Mercury	µg/L	2	1	0.21 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	**2.5 J**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	**48000**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	**1.6**	**1.5**	**4.9 J**	**0.53**	**0.064 J**	0.2 U	**0.14 J**	**0.1 J**	**0.38**	**0.44**	**0.15 J**	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	**250**	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	**12.9**	**7.56**	0.5 U	**2.15**	**1.98**	**3.36**	**25.1**	**13**	**0.44 J**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	10 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	G-58				JAW-78				JAW-79
					Sample ID	G-58-F01R9	L800-G-58-0818	JAW-78-050300	JAW-78-20001122	JAW-78-20010506	JAW-78-20020628	JAW-78-20040606	JAW-79-050300	JAW-79-20001122
					Sample Depth (ft)	20 - 30	20 - 30	50 - 65	50 - 65	50 - 65	50 - 65	50 - 65	25 - 35	25 - 35
					Sample Date	8/25/2009	8/27/2018	5/3/2000	11/22/2000	5/6/2001	6/28/2002	6/6/2004	5/3/2000	11/22/2000
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**									
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	- -	- -	- -	**400000**	**460000**	**460000**	**420000**	- -	**370000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	**230**	- -	**200**	**200 J**	- -	**400**
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	- -	- -	**50000**	**160000**	**200000**	**85000**	- -	**40000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	- -	1000 U
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	**3000**	1000 U	1000 U	1000 U	- -	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	**400**	**400**	**400**	**1000**	- -	**600**
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	810 B	- -	- -	**1800**	**1300**	**1500**	**1600**	- -	**1200**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	- -	1000 U
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	**60**	10 U	10 U	50 U	- -	20 U
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	- -	- -	- -	**12000**	**11000**	**11000**	**10000**	- -	**6700**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	**0.11 J**	0.16 U	0.57 U	0.43 U	1.2 U	0.48 U	0.16 U	1.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	0.1 UJ	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**5.6**	**6 J**	- -	0.57 U	0.53 U	1.2 U	0.48 U	- -	1.2 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.2 U	0.1 UJ	0.16 U	0.57 U	0.43 U	1.2 U	0.48 U	0.16 U	1.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.2 U	0.1 UJ	0.16 U	0.57 U	0.43 U	1.2 U	0.48 U	0.16 U	1.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.2 U	***0.058 J***	0.31 U	0.57 U	0.43 U	1.2 U	0.48 U	0.31 U	1.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	**0.19 J**	0.1 UJ	0.31 U	0.57 U	0.43 U	1.2 U	0.48 U	0.31 U	1.2 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	0.2 UJ	0.31 U	0.57 U	0.43 U	1.2 U	1.9 U	0.31 U	1.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	0.2 UJ	0.31 U	0.57 U	0.43 U	1.2 U	0.48 U	0.31 U	1.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**0.55**	**0.33 J**	0.31 U	0.57 U	0.43 U	1.2 U	0.48 U	0.31 U	1.2 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	0.2 UJ	0.78 U	0.57 U	0.43 U	1.2 U	0.48 U	0.78 U	1.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.8 U	**0.28 J**	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.6 U	0.1 UJ	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**38.1**	**57 J**	0.39 U	0.57 U	0.43 U	1.2 U	0.48 U	0.39 U	1.2 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	0.1 UJ	0.16 U	0.57 U	0.43 U	1.2 U	0.48 U	0.16 U	1.2 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***284***	***410 J***	0.16 U	0.54 U	0.43 U	1.2 U	0.48 U	0.16 U	1.1 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	0.1 UJ	0.31 U	0.57 U	0.43 U	1.2 U	0.48 U	0.31 U	1.2 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	**6.2 J**	- -	**9.6 J**	- -	- -	**5.2 J**	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	**289**	- -	**538**	- -	- -	**442**	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	0.4 U	- -	5 U	- -	- -	0.4 U	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	**100000**	**109000**	- -	- -	- -	**87700**
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	**3.8 J**	- -	**2.4 J**	- -	- -	**3.5 J**	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	1.7 U	- -	10 U	- -	- -	1.7 U	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	**36800**	**40100**	- -	- -	- -	**27000**
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	0.1 U	- -	0.21 U	- -	- -	0.1 U	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	2.6 U	- -	10 U	- -	- -	2.6 U	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	2.8 U	- -	10 U	- -	- -	2.8 U	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	**20400**	**22200**	- -	- -	- -	**15500**
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.2 U	- -	0.16 U	0.57 U	0.43 U	1.2 U	0.48 U	0.16 U	1.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	10 U	- -	- -	- -	10 U
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	10 U	- -	- -	- -	10 U
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	3 U	- -	- -	- -	3 U

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
					Location	JAW-79			L800-TT-MW01				
					Sample ID	JAW-79-20010606	JAW-79-20020627	JAW-79-20040606	800-TT-MW1	800-TT-MW01-150605	L800-TT-MW1-01R2	L800-TT-MW1-01R3	L800-TT-MW1-01R4
					Sample Depth (ft)	25 - 35	25 - 35	25 - 35	1 - 6.4	1 - 6.4	1 - 6.4	1 - 6.4	1 - 6.4
					Sample Date	6/6/2001	6/27/2002	6/6/2004	5/16/2005	6/15/2005	7/15/2005	8/26/2005	11/8/2005
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**370000**	**380000**	**360000**	**170000**	**390000**	**440000**	**415000**	**130000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	**310**	**350**	**350**	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**100000**	**170000**	**65000**	**1800000**	**2000000**	- -	**2450000**	**1820000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	**600**	**600**	1000 U	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	1000 U	**1300**	**1400**	**2100**	**20000000**	**2900000**	**523000**	**286000**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	1000 U	1000 U	1000 U	**16000**	**20000**	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	200 U	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	- -	- -	- -	**200**	200 U	200 U	**640**	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	10 U	10 U	50 U	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	- -	- -	- -	100 U	100 U	1000 U	**1000**	**690**
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**6000**	**6000**	**5000**	**200000**	**160000**	**120000**	**123000**	**54600**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	1.3 U	0.7 U	0.51 U	0.48 U	**1.3 P**	**11:00 PM**	**0.39**	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	1.1 U	0.7 U	14 U	0.48 U	***0.51 JP***	0.48 U	0.19 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	- -	- -	- -	0.48 U	**0.25 JP**	0.48 U	**0.37**	**0.67**
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	- -	0.48 U	0.52 U	**0.51 P**	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	1.1 U	0.7 U	0.51 U	0.48 U	**0.34 JP**	**0.29 JP**	0.19 U	0.19 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	1.1 U	0.7 U	0.51 U	***2.7***	**1.7 P**	0.48 U	0.19 U	0.19 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	**92100**	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	- -	- -	- -	**4150**	***130000***	***86500***	**13400**	**13100**
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	**28400**	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	- -	- -	- -	**221**	***2890***	***3490***	***1410***	***733***
METALS	7439-97-6	Mercury	μg/L	2	1	0.21 U	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	**16000**	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	1.1 U	0.7 U	0.51 U	0.48 U	0.52 U	0.48 U	0.19 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	3 U	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	3 U	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	3 U	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	3 U	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	3 U	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	10 U	10 U	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	3 U	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	**2**	**2**	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	10 U	10 U	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	3 U	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	3 U	3 U	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	3 U	3 U	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	L800-TT-MW01						L800-TT-MW02	
					Sample ID	L800-TT-MW1-02R1	L800-TT-MW1-02R2	L800-TT-MW01-FBL	L800-TT-MW-01-F01R4	L800-TT-MW01-F01R5	L800-TTMW01-0818	800-TT-MW2	800-TT-MW02-150605
					Sample Depth (ft)	1 - 6.4	1 - 6.4	1 - 6.4	1 - 6.4	1 - 6.4	1 - 6.4	25 - 30	25 - 30
					Sample Date	2/3/2006	4/6/2006	3/21/2007	3/11/2008	5/22/2008	8/29/2018	5/16/2005	6/15/2005
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**825000**	**223000**	**182000**	**308000**	**288000**	- -	**390000**	**390000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**1820000**	**366000**	**298000**	**354000**	**609000**	- -	**140000**	**220000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**69600**	**17800**	**4200**	**46000**	**2600**	- -	**5800**	**180000**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	**9000**	**9000**
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	**300**
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	50 U	**300**	**2100**	***35700***	50 U	- -	**4900**	**4900**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	***3400***	**110**	50 U	50 U	50 U	- -	100 U	100 U
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**97200**	**70800**	**204000**	**32400**	**137000**	- -	**69000**	**68000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	**0.5**	**0.9**
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	0.1 U	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.2 U	0.19 U	0.19 U	**0.5**	0.19 U	0.1 U	**48**	**38**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	**1.4**	***7.7***
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.48 U	***0.57***
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	***1.4***	***1.7***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.2 U	0.19 U	***6.8***	0.19 U	0.19 U	0.1 U	**0.53**	**1.8**
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.2 U	0.19 U	***25***	0.19 U	0.19 U	0.1 U	**0.87**	***2.5***
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.2 U	0.19 U	0.19 U	**1.2**	0.19 U	0.2 U	**2.6**	**1.2 P**
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.2 U	0.19 U	0.19 U	**0.11 J**	0.19 U	0.1 U	**3.3**	**3.3**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.2 U	0.19 U	0.19 U	**0.19**	0.19 U	0.1 U	**86 D**	**91 D**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.48 U	0.5 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.2 U	0.19 U	0.19 U	***23.8***	0.19 U	0.1 U	***4400 D***	***4200 D***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.1 U	0.48 U	0.5 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	**7830**	**2980**	**4030**	15 U	**2650**	- -	**441**	**2980**
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***1230***	***1040***	**305**	2.2 B	**311**	- -	**321**	**310**
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	- -	0.48 U	**0.52**
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	**2390**	0.5 U	**1990**	- -	**170**	**44**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW02						L800-TT-MW03	
					Sample ID	L800-TT-MW2-01R2	L800-TT-MW2-01R3	L800-TT-MW2-01R4	L800-TT-MW2-02R1	L800-TT-MW2-02R2	L800-TT-MW02-FBL	800-TT-MW3	800-TT-MW03-150605
					Sample Depth (ft)	25 - 30	25 - 30	25 - 30	25 - 30	25 - 30	25 - 30	25 - 30	25 - 30
					Sample Date	7/13/2005	8/26/2005	11/7/2005	2/2/2006	4/7/2006	3/21/2007	5/16/2005	6/15/2005
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**390000**	**353000**	**395000**	**360000**	**453000**	**1020000**	**320000**	**310000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**480000**	**1820000**	**1020000**	**2570000**	**3240000**	**55000**	**90000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**5800**	**5900**	**3700**	**941000**	**556000**	**1220000**	**4600**	**2800**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	**6000**	**7000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	**400**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**4300**	**8400**	**1000**	**9800**	**4500**	50 U	**600**	**500**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	100 U	**240**	50 U	***2000***	***1900***	***2400***	100 U	100 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**66000**	**58600**	**123000**	**51100**	**11100**	**9600**	**110000**	**120000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	**0.38 J**	0.19 U	**0.34**	20 U	3.8 U	0.19 U	**0.36 J**	**0.84**
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**43**	**42.7**	**19.3**	**29.2**	**9**	**0.52**	**17**	**14**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***3.3***	***5.8***	***5.1***	20 U	***6.2***	0.19 U	***6.8***	***11***
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.48 U	***0.28***	***0.45***	***7.5 J***	***2.3 J***	0.19 U	***0.56***	***0.54***
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***1.6***	***2.5***	***0.95***	***14.8 J***	***4.9***	0.19 U	***0.47 J***	***0.76***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	**0.5 P**	**0.85**	**0.71**	***12.6 J***	***4.8***	0.19 U	***2.3***	0.49 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.48 U	0.19 U	0.2 U	20 U	3.8 U	0.19 U	0.48 U	0.49 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.48 U	0.19 U	0.2 U	20 U	3.8 U	0.19 U	0.48 U	0.49 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**1.5**	***2.6***	**1.4**	***38.3***	***15.2***	0.19 U	***3.1***	***3***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.48 U	0.19 U	0.2 U	20 U	3.8 U	0.19 U	**0.61 P**	0.49 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**1.9**	**4**	**5**	**28.9**	**137**	**2.4**	**1.9 P**	**2:00 PM**
EXPLOSIVES	DNX	DNX	µg/L	--	--	**3.4**	**8.3**	**4.1**	**27.5**	**17.7**	**0.4**	**3.2**	**2.4 P**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**83 D**	**94.4**	**36.9**	**284**	**92.1**	**3.3**	**45**	**58 D**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.48 U	0.19 U	0.2 U	20 U	3.8 U	0.19 U	0.48 U	0.49 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***4200 D***	***3840***	***795***	***1230***	***296***	**0.84**	***630 D***	***690 D***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.48 U	0.19 U	0.2 U	20 U	3.8 U	0.19 U	0.48 U	0.49 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	**1030**	**1610**	**3060**	***34200***	**13800**	***39600***	***34800***	**4410**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	**370**	**354**	***604***	***2320***	***1200***	***2160***	***741***	**428**
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.48 U	**0.53**	**0.26**	**5.9 J**	3.8 U	0.19 U	0.48 U	0.49 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	**6550**	**30**	**15**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW03						L800-TT-MW04	
					Sample ID	L800-TT-MW3-01R2	L800-TT-MW3-01R3	L800-TT-MW3-01R4	L800-TT-MW3-02R1	L800-TT-MW3-02R2	L800-TT-MW03-FBL	800-TT-MW4	800-TT-MW04-150605
					Sample Depth (ft)	25 - 30	25 - 30	25 - 30	25 - 30	25 - 30	25 - 30	20 - 25	20 - 25
					Sample Date	7/15/2005	8/26/2005	11/7/2005	1/30/2006	4/6/2006	3/21/2007	5/16/2005	6/15/2005
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**310000**	**339000**	**313000**	**475000**	**695000**	**750000**	**260000**	**240000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**376000**	- -	**674000**	**1050000**	**1670000**	**110000**	**110000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**4000**	**4400**	**4900**	**12800**	**434000**	**707000**	**3500**	**170000**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	**9000**	**10000**
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	**200**
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**2400**	**1000**	**1100**	50 U	**1200**	50 U	200 U	200 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	100 U	**210**	**220**	50 U	50 U	***1600***	100 U	100 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**86000**	**82800**	**82600**	**113000**	**27600**	**17400**	**200000**	**220000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	**0.071 J**	**1.2**	**4**	**0.2**	0.2 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**4.2**	**6.9**	**3.9**	**0.11 J**	**3.8**	0.2 U	**3.2 P**	**3.2**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	**1.1**	***11.5***	***41.7***	**1.8**	0.2 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.48 U	***0.49***	***1.9***	0.2 U	0.2 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.48 U	***0.37***	***1.2***	0.2 U	***0.36***	0.2 U	0.48 U	0.5 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	**0.23 JP**	**0.94**	***3***	**0.15 J**	**0.48**	**0.11 J**	0.48 U	**0.26 J**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.48 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.48 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**0.59**	**1.6**	***4.6***	**0.21**	***2.6***	**0.39**	**0.13 JP**	**0.31 J**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.48 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**1.2 P**	**3.4**	**2.1**	**0.26**	**1.7**	0.2 U	**1.2**	**1.1**
EXPLOSIVES	DNX	DNX	µg/L	--	--	**1.9**	**3.5**	**1.1**	**0.48**	**1.3**	0.2 U	**2:00 PM**	**1.5 P**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**11**	**29.1**	**52.9**	**5.6**	**34**	**0.92**	**7.5**	**15**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.48 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.48 U	0.5 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***100 D***	***239***	***247***	***12.1***	***304***	***2.1***	***62 D***	***150 D***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.48 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.48 U	0.5 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	***14200***	**3400**	***27700***	***24300***	***63500***	***45200***	***14600***	**12100**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	***680***	**477**	***581***	**515**	***1010***	***1670***	**331**	**284**
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.48 U	**0.18 J**	**1.2**	0.2 U	0.2 U	0.2 U	0.48 U	0.5 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	**5570**	**30**	**25**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
					Location	L800-TT-MW04							
					Sample ID	L800-TT-MW4-01R2	L800-TT-MW4-01R3	L800-TT-MW4-01R4	L800-TT-MW4-02R1	L800-TT-MW4-02R2	L800-TT-MW04-FBL	L800-TT-MW-04-F01R6	L800-TTMW04-0818
					Sample Depth (ft)	20 - 25	20 - 25	20 - 25	20 - 25	20 - 25	20 - 25	20 - 25	20 - 25
					Sample Date	7/15/2005	8/26/2005	11/8/2005	2/3/2006	4/10/2006	3/21/2007	9/30/2008	8/29/2018
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**350000**	**220000**	**250000**	**295000**	**390000**	**558000**	**377000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	- -	**297000**	**943000**	**380000**	**601000**	**791000**	**486000**	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**720000**	**2600**	**2400**	**4300**	**11700**	**4800**	**2400**	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	**700**	**480**	80 B	80 B	**100**	**420**	**110**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	1000 U	**190**	50 U	50 U	50 U	50 U	50 U	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**210000**	**243000**	**163000**	**148000**	**73500**	**77800**	**62400**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.48 U	0.19 U	0.21 U	0.21 U	0.2 U	0.19 U	0.19 U	0.11 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -	0.11 U
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**1.1**	**0.23**	**1.9**	**0.14 J**	**2.6**	**0.57**	0.19 U	0.11 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	**0.41 JP**	0.19 U	**0.4**	0.21 UN	**2.2**	***4.5***	0.19 U	0.11 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.48 U	0.19 U	0.21 U	0.21 U	**0.1 J**	**0.15 J**	0.19 U	0.11 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.48 U	0.19 U	***0.21***	0.21 U	***0.41***	***0.22***	0.19 U	0.11 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	**0.84 P**	0.19 U	**0.45**	**0.086 J**	***4.3***	***7.6***	**0.097 J**	0.11 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.48 U	0.19 U	0.21 U	0.21 U	0.2 U	0.19 U	0.19 U	0.21 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.48 U	0.19 U	0.21 U	0.21 U	0.2 U	0.19 U	0.19 U	0.21 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**0.79 P**	0.19 U	**0.78**	**0.11 J**	***5.5***	***19.8***	**0.21**	0.11 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.48 U	0.19 U	0.21 U	0.21 U	0.2 U	0.19 U	0.19 U	0.21 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**0.61**	**0.078 J**	**0.84**	**0.19 J**	**7.2**	**0.65**	**0.15 J**	0.21 U
EXPLOSIVES	DNX	DNX	μg/L	--	--	**0.28 JP**	0.19 U	**0.67**	0.21 U	**1.2**	**0.085 J**	0.19 U	0.11 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**12**	**1.2**	**17.2**	**2.3**	**86.5**	**57.5**	**5.7**	**0.22**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.48 U	0.19 U	0.21 U	0.21 U	0.2 U	0.19 U	0.19 U	0.11 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***33***	***4.2***	***87.8***	***8.1***	***87.7***	***56.7***	***2.4***	0.11 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.48 U	0.19 U	0.21 U	0.21 U	**0.26**	0.19 U	0.19 U	0.11 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	***21400***	**6510**	**7190**	**10700**	***18300***	**11000**	**4100**	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	**396**	**300**	**332**	**164**	**396**	**328**	**154**	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.48 U	0.19 U	0.21 U	0.21 U	0.2 U	0.19 U	0.19 U	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	**5260**	**2680**	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW05							
					Sample ID	800-TT-MW5	800-TT-MW5-FD	800-TT-MW05-140605	L800-TT-MW5-01R2	L800-TT-MW5-01R3	L800-TT-MW5-01R4	L800-TT-MW5-02R1	L800-TT-MW5-02R2
					Sample Depth (ft)	20 - 25	20 - 25	20 - 25	20 - 25	20 - 25	20 - 25	20 - 25	20 - 25
					Sample Date	5/16/2005	5/17/2005	6/14/2005	7/13/2005	8/25/2005	11/7/2005	2/2/2006	4/7/2006
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**290000**	**450000**	**520000**	**570000**	**265000**	**538000**	**485000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**2000000**	**2000000**	- -	**2080000**	**4350000**	**1180000**	**972000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**2800**	- -	**2600000**	**1500000**	**573000**	**207000**	**252000**	**59500**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	**11000**	- -	**14000**	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	200 U	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	200 U	200 U	200 U	50 U	50 U	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	100 U	100 U	1000 U	***14800***	50 U	**190**	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**200000**	- -	**190000**	**150000**	**89000**	**80600**	**92700**	**51000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**5.2**	- -	**43**	**26**	**3.1**	0.19 U	0.2 U	0.2 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.48 U	- -	**0.15 JP**	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**0.81**	- -	**3.8**	**3.6**	**9.5**	**12.9**	**11.6**	**6.1**
EXPLOSIVES	DNX	DNX	µg/L	--	--	**0.97 P**	- -	**23**	**12**	**2.3**	**0.2**	0.2 U	0.2 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**1.5**	- -	**20**	**22**	**17.3**	**0.65**	**1.4**	0.2 U
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.48 U	- -	**0.069 JP**	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***220 D***	- -	***65 D***	***41***	***6.2***	0.19 U	**0.63**	0.2 U
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	**2190**	***18100***	***19200***	***27600***	***18200***	***30000***	**10500**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	**178**	***712***	***2040***	***1730***	***789***	***2820***	***2140***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.48 U	- -	0.52 U	0.48 U	0.19 U	0.19 U	0.2 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**55**	- -	**3**	- -	- -	- -	- -	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW05	L800-TT-MW06					
					Sample ID	L800-TT-MW05-FBL	L800-TT-MW06-FBL	L800-TT-MW06-F01R1	L800-TTMW-06-F01R2	L800-TTMW-06-F01R3	L800-TTMW-06-F01R3FD	800-TTMW-06-F01R4
					Sample Depth (ft)	20 - 25	15 - 25	15 - 25	15 - 25	15 - 25	15 - 25	15 - 25
					Sample Date	3/20/2007	4/30/2007	12/4/2007	1/10/2008	2/19/2008	2/19/2008	3/13/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**503000**	**318000**	**383000**	**448000**	**380000**	**350000**	**498000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**983000**	**385000**	**609000**	**543000**	**408000**	**369000**	**637000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**6000**	**2200**	**2500**	**52600**	**75200**	**77500**	**94600**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	50 U	***57400***	***57600***	***33700***	***66600***	***74600***	***17000***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	**210**	***2900***	***3100***	50 U	50 U	**100**
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**73800**	**61400**	**88100**	**129000**	**81200**	**67500**	**142000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.2 U	2.1 U	1.9 U	**0.13 J**	**0.2**	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.19 U	**59.6 J**	**17**	**24**	**27**	**26.1**	**31.9 J**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.2 U	2.1 U	1.9 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	**0.12 J**	2.1 U	1.9 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	***2.4***	2.1 U	***0.7 J***	***0.59***	***0.6***	***0.53***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	***4.5***	**1.6 J**	***3***	***3.1***	***3.2***	***2.5***
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.2 U	2.1 U	1.9 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.19 U	0.2 U	2.1 U	1.9 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	***5.6***	**1.8 J**	**1.9**	***2.2***	***2.5***	**1.8**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.2 U	2.1 U	1.9 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	0.19 U	**45.5 J**	**13.6**	**14**	**14.6**	**14.4**	**16.3**
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.19 U	**35.7 J**	**10.4**	**8.5**	**10**	**9.7**	**10.2**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.19 U	**206**	**73.1**	**236**	**222**	**216**	**250**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.2 U	2.1 U	1.9 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.19 U	***4910***	***1530***	***1860***	***2060***	***2080***	1980 B
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.2 U	2.1 U	1.9 U	0.2 U	0.2 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	**7860**	**1110**	***15400***	**1850**	***22500***	***20700***	**1280**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	***1540***	**105**	**351**	**43.8**	**496**	**482**	**28.3**
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	**1.1**	2.1 U	1.9 U	0.2 U	0.2 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**9130**	**0.42 J**	**0.16 J**	0.5 U	0.5 U	0.5 U	0.5 U
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	L800-TT-MW06		L800-TT-MW07				
					Sample ID	L800-TT-MW06-F01R5	L800-TT-MW-06-F01R6	L800-TT-MW07-FBL	L800-TT-MW07-F01R1	L800-TT-MW07-F01R1-FD	L800-TTMW-07-F01R2	L800-TTMW-07-F01R3
					Sample Depth (ft)	15 - 25	15 - 25	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30
					Sample Date	5/22/2008	9/30/2008	4/27/2007	12/4/2007	12/4/2007	1/11/2008	2/19/2008
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**423000**	**364000**	**308000**	**360000**	**360000**	**330000**	**348000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**605000**	**447000**	**281000**	**474000**	**510000**	**428000**	**402000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**2100**	**1800**	**3000**	**1800**	**1800**	**50500**	**58100**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	***18200***	***11000***	***28700***	***37200***	***37100***	***49300***	***48400***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	50 U	**200**	***6000***	***6100***	***2800***	***1100***
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**142000**	**140000**	**51500**	**59100**	**56700**	**67400**	**59900**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	19 U	**0.096 J**	19 U	2 U	9.9 U	9.9 U	0.97 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**28.9**	**23**	**16.9 J**	**30.5**	**35.3**	**32.3**	**31.7**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	19 U	0.19 U	19 U	2 U	9.9 U	9.9 U	0.97 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	19 U	0.19 U	19 U	2 U	9.9 U	9.9 U	0.97 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	19 U	***0.42***	19 U	***1.4 J***	9.9 U	9.9 U	***3.1***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	19 U	***2.2***	19 U	***2.7***	***3.5 J***	***4.5 J***	***3.7***
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	19 U	0.19 U	19 U	2 U	9.9 U	9.9 U	0.97 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	19 U	0.19 U	19 U	2 U	9.9 U	9.9 U	0.97 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	19 U	**1.4**	19 U	***4.8***	***6.7 J***	***7.8 J***	***6.7***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	19 U	0.19 U	19 U	2 U	9.9 U	9.9 U	0.97 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	19 U	**11**	**18.4 J**	**20.4**	**23.1**	**21.6**	**17.4**
EXPLOSIVES	DNX	DNX	µg/L	--	--	19 U	**7.4**	**13.5 J**	**18.7**	**21.9**	**17.5**	**14.8**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**216**	**197**	**60.1**	**87.6**	**106**	**97.2**	**92.4**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	19 U	0.19 U	19 U	2 U	9.9 U	9.9 U	0.97 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***1860***	***1660***	***1400***	***3140***	***3270***	***3410***	***3420***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	19 U	0.19 U	19 U	2 U	9.9 U	9.9 U	0.97 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	**1770**	**1040**	234 B	**1700**	**2270**	**4340**	**1490**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	**41.2**	**29**	**153**	**292**	**238**	**194**	**114**
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	19 U	0.19 U	19 U	2 U	9.9 U	9.9 U	**0.73 J**
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	0.5 U	**0.41 J**	**1.56**	**0.16 J**	**0.17 J**	**0.41 J**	**0.27 J**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW07			L800-TT-MW08			
					Sample ID	800-TTMW-07-F01R4	L800-TT-MW07-F01R5	L800-TT-MW-07-F01R6	L800-TTMW-8-FBL	L800-TT-MW08-F01R1	L800-TTMW-08-F01R2	L800-TTMW-08-F01R3
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30
					Sample Date	3/13/2008	5/22/2008	9/30/2008	4/5/2007	12/5/2007	1/11/2008	2/20/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95(1))**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**470000**	**335000**	**262000**	**450000**	**508000**	**450000**	**451000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**980000**	**568000**	**345000**	**1410000**	**572000**	**484000**	**599000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**73600**	**2400**	**2900**	**1400**	**1700**	**65100**	**92000**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	***52600***	***58700***	***102000***	**660**	**1400**	**2900**	**450**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	**820**	**710**	**380**	50 U	***2600***	***2200***	**110**
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**58900**	**63800**	**65400**	**30100**	**47900**	**49600**	**29400**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	1.9 U	1.9 U	3.8 U	0.19 U	**0.14 J**	**0.12 J**	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**28.6**	**31.4**	**30.5**	**2.6**	**6.5**	**2.5**	**3.6**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	1.9 U	1.9 U	3.8 U	**0.49**	**1.1**	**0.92**	**1**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	1.9 U	1.9 U	3.8 U	**0.22**	**0.2**	0.2 U	**0.11 J**
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***2.3***	***2.4***	***4.5***	***0.26***	***1.5***	***0.26***	***0.93***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***3.4***	***3.5***	***3.5 J***	**0.31**	**0.53**	**0.28**	**0.43**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	1.9 U	1.9 U	3.8 U	0.19 U	**0.11 J**	0.2 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	1.9 U	1.9 U	3.8 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***6.2***	***6.3***	***6***	**0.58**	**1.4**	**0.5**	**0.82**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	1.9 U	1.9 U	3.8 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**24.6**	**18.6**	**15.3**	**4**	**5.8**	**1.5**	**2.4**
EXPLOSIVES	DNX	DNX	µg/L	--	--	**15.9**	**14.3**	**13.9**	**1.1**	**2.4**	**0.67**	**1**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**80.9**	**73.3**	**109**	**5.6**	**14**	**6**	**9.1**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	1.9 U	1.9 U	3.8 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***2310***	***2970***	***3380***	***88.1***	***223***	***57.4***	***116***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	1.9 U	1.9 U	3.8 U	0.19 U	**3.3**	0.2 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	**2480**	**1440**	**509**	15 U	**389**	136 B	15 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	**112**	**102**	**151**	**515**	***629***	**575**	**567**
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	1.9 U	**0.84 J**	3.8 U	0.19 U	0.19 U	0.2 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**0.21 J**	**0.98**	**1.2**	**1.22**	**3.42**	**0.19 J**	**0.49 J**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW08			L800-TT-MW09			
					Sample ID	800-TTMW-08-F01R4	L800-TT-MW08-F01R5	L800-TT-MW-08-F01R6	L800-TT-MW09-FBL	L800-TT-MW09-F01R1	L800-TTMW-09-F01R2	L800-TTMW-09-F01R3
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30
					Sample Date	3/13/2008	5/23/2008	9/30/2008	4/6/2007	12/7/2007	1/11/2008	2/20/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**480000**	**373000**	**410000**	**670000**	**358000**	**648000**	**688000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**663000**	**538000**	**482000**	**792000**	**627000**	**785000**	**1010000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**96100**	**1700**	**1600**	**5000**	**3300**	**105000**	**150000**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**2900**	**3400**	**3200**	**1400**	**5800**	**6700**	**1200**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	**110**	**180**	50 U	50 U	***4400***	***4100***	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**33100**	**113000**	**101000**	**106000**	**96200**	**97500**	**94300**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	**0.1 J**	**0.2**	0.19 U	0.2 U	0.2 U	**2.1**	**0.23**
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**1.8**	**7**	**4.5**	**1.7**	**12**	**14.1**	**0.92**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	**0.77**	***2.6***	**1.3**	***4.3***	***134***	***320***	***31.2***
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	***0.28***	***0.3***	***0.29***	***8.3***	***3.7***	***0.74***
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***0.2***	***0.31***	***0.34***	***0.34***	***7.1***	***12.7***	***1.1***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	**0.31**	**1.6**	**1.2**	**0.18 J**	***17.6***	***17.1***	**1.7**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.2 U	0.19 U	0.2 U	0.2 U	0.95 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.19 U	0.2 U	0.19 U	0.2 U	0.2 U	0.95 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**0.48**	***2.1***	**1.8**	**0.66**	***22***	***29.4***	***2.8***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.2 U	0.19 U	0.2 U	0.2 U	0.95 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**1.2**	**3.2**	**3**	**0.96**	**2.5**	**1.9**	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	**0.61**	**1.4**	**1.5**	**0.47**	**2.7**	**2.6**	0.2 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**5.1**	**21.2**	**24.8**	**9.5**	**150**	**262**	**14.3**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.2 U	0.19 U	0.2 U	0.2 U	0.95 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***50***	***207***	***143***	***52.1***	***778***	***1170***	***62.2***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.2 U	0.19 U	0.2 U	0.2 U	0.95 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	272 B	15 U	259 B	***49900***	**6160**	**4830**	**2200**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	**483**	**296**	**407**	***1270***	***801***	***843***	***806***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.2 U	0.19 U	**0.34**	**4.7**	0.95 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**0.9**	**0.98**	**11.4**	**0.61**	**122**	**198**	**223**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW09					L800-TT-MW10	
					Sample ID	800-TTMW-09-F01R4	L800-TT-MW09-F01R5	L800-TT-MW-09-F01R6	L800-TT-MW09-01R7	L800-TTMW09-0818	L800-TT-MW10-FBL	L800-TT-MW10-F01R1
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30
					Sample Date	3/14/2008	5/23/2008	10/1/2008	3/9/2009	8/28/2018	4/6/2007	12/7/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**588000**	**568000**	**483000**	**1160000**	- -	**310000**	**295000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**827000**	**737000**	**657000**	**5060000**	- -	**591000**	**517000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**142000**	**3400**	**3000**	**84200**	- -	**2600**	**2800**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	***23100***	***25500***	***29000***	**9500**	- -	**9500**	**260**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	***1100***	**860**	***1200***	**750**	- -	**150**	***2800***
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**88000**	**89800**	**82900**	**29600**	- -	**161000**	**139000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	**0.35**	**0.73**	**0.8**	1.5 U	**1.3 J**	0.22 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	0.54 UJ	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**3.7**	**4.8**	**5.7**	**31.5**	**43 J**	**3.1**	**1.6**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	***98.6***	***71.1***	***91.3***	1.5 U	***9.7 J***	**0.29**	**0.94**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	***2.4***	***2.3***	***3.3***	***1 J***	***3.2 J***	0.22 U	**0.13 J**
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	***3.2***	***1.9***	***2.6***	***1.4 J***	***4.3 J***	***0.25***	***1.1***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	***4.1***	***2.9***	***4.1***	***2.6***	***18 J***	0.22 U	**0.21**
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	0.2 U	0.19 U	1.5 U	1.1 UJ	0.22 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	0.2 U	0.19 U	1.5 U	1.1 UJ	0.22 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	***7.2***	***4.8***	***6.9***	***17.3***	***30 J***	**0.5**	**0.7**
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	0.2 U	0.19 U	1.5 U	1.1 UJ	0.22 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.2 U	**0.66**	**4.8**	4.5 U	**110 J**	**0.87**	**0.16 J**
EXPLOSIVES	DNX	DNX	μg/L	--	--	**0.51**	**1.1**	**2.6**	**7.3**	**36 J**	**0.68**	**0.18 J**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**67.3**	**49.6**	**87**	**353**	**190 J**	**3.5**	**7.6**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	0.2 U	0.19 U	1.5 U	***3.4 J***	0.22 U	0.2 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***285***	***204***	***280***	***558***	***630 J***	***90.6***	***155***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	0.2 U	0.19 U	1.5 U	0.54 UJ	0.22 U	0.2 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	**3280**	**2880**	**1620**	***112000***	- -	**5940**	**1300**
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***687***	***777***	***871***	***7520***	- -	**543**	**256**
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	**0.47**	**1.2**	**2**	1.5 U	- -	0.22 U	**0.18 J**
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**175**	**137**	**121**	**37.4**	- -	**1.46**	**8.22**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	L800-TT-MW10						L800-TT-MW11
					Sample ID	L800-TTMW-10-F01R2	L800-TTMW-10-F01R3	800-TTMW-10-F01R4	L800-TT-MW10-F01R5	L800-TT-MW-10-F01R6	L800-TTMW-10-F01R9	L800-TTMW-11-FBL
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30
					Sample Date	1/11/2008	2/21/2008	3/14/2008	5/28/2008	10/1/2008	9/2/2009	4/5/2007
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**270000**	**300000**	**300000**	**278000**	**232000**	- -	**515000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**383000**	**449000**	**625000**	**629000**	**321000**	- -	**854000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**55200**	**69400**	**73000**	**2900**	**1900**	**1500**	**8500**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**4300**	**2000**	**3800**	**4400**	**4900**	- -	***13800***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	***2400***	50 U	**170**	**690**	50 U	- -	**460**
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**133000**	**139000**	**131000**	**134000**	**137000**	- -	**68800**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	**0.12 J**	1 U	**0.38**	7.8 U	**0.73**	**8.9 J**	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**5.2**	**8**	**10.5**	**10.6**	**5.2**	20 U	**6.8**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***3***	***30.5***	***20.2***	***9.4***	***20***	***56.3***	**0.37**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	**0.21**	***0.96 J***	***0.46***	7.8 U	***0.75***	20 U	***0.31***
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***1***	***7.3***	***5.4***	7.8 U	***4.9***	***16.2 J***	***2.5***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	**0.28**	**1.3**	**1.6**	7.8 U	***2***	***8.1 J***	**1.1**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	1 U	0.2 U	7.8 U	0.19 U	20 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.19 U	1 U	0.2 U	7.8 U	0.19 U	20 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**0.57**	***3.6***	***3.2***	7.8 U	***3.5***	***11.4 J***	***5***
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	1 U	0.2 U	7.8 U	0.19 U	20 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**1.4**	**0.74 J**	**0.74**	7.8 U	0.19 U	20 U	**3.7**
EXPLOSIVES	DNX	DNX	µg/L	--	--	**1.4**	**1.4**	**1.9**	7.8 U	**0.65**	20 U	**2.5**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**10.5**	**52.8**	**45**	**26.4**	**43.4**	**122**	**29.3**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	1 U	0.2 U	7.8 U	0.19 U	20 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***145***	***828***	***651***	***407***	***487***	***1240***	***515***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	1 U	0.2 U	7.8 U	0.19 U	20 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	**2330**	**1120**	**4780**	**639**	**1520**	- -	**2110**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	**415**	**363**	**337**	**400**	**403**	- -	***1240***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	1 U	0.2 U	7.8 U	**0.14 J**	20 U	**0.63**
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**0.79**	**0.76**	**0.91**	**0.68**	**2.57**	- -	0.5 U
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])							
					Location	L800-TT-MW11						
					Sample ID	L800-TT-MW11-F01R1	L800-TTMW-11-F01R2	L800-TTMW-11-F01R3	800-TTMW-11-F01R4	L800-TT-MW11-F01R5	L800-TT-MW-11-F01R6	L800-TT-MW11-01R7
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30
					Sample Date	12/7/2007	1/15/2008	2/21/2008	3/19/2008	5/28/2008	9/30/2008	3/6/2009
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**273000**	2500 U	**2440000**	**1800000**	**1540000**	**435000**	**784000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**1610000**	5000 U	**10200000**	**13200000**	**4900000**	**3690000**	**233000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**12300000**	**6050000**	**3670000**	**3120000**	**1420000**	**971000**	**48400**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	50 U	50 U	100 U	**1900**	**460**	100 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	50 U	100 U	100 U	***2100***	**450**	***4400***	**510**
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**54900**	**96800**	**51600**	**49100**	**34500**	**8300**	1000 U
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.22 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**4.9**	**6.6**	**17.5**	**10.8**	**12.7**	0.19 U	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.22 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.22 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.22 U	0.19 U	0.2 U	***3.7***	0.2 U	0.19 U	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.22 U	0.19 U	0.2 U	**0.088 J**	0.2 U	0.19 U	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.22 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.22 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.22 U	**0.2**	0.2 U	***2.8***	0.2 U	0.19 U	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.22 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**2.4**	**2.8**	**8**	0.19 U	**14.5**	**8.4**	**49.7**
EXPLOSIVES	DNX	DNX	μg/L	--	--	**0.45**	**2.9**	**9.3**	**1.8**	**5.8**	0.19 U	0.19 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**3.6**	**10.5**	**26.4**	**114**	**26.5**	**2.2**	0.19 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.22 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	0.22 U	***17.7***	***15.9***	***1380***	***12.7***	0.19 U	0.19 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.22 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	***946000***	***240000***	***412000***	***271000***	***204000***	***47300***	**8830**
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***13400***	***12700***	***7040***	***5670***	***2640***	***2930***	***1420***
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.22 U	0.19 U	0.2 U	**0.38**	0.2 U	0.19 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**0.74**	**1.53**	0.5 U	**2.57**	**4.79**	**4.48**	**381**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW12		L800-TT-MW13				
					Sample ID	L800-TT-MW12-FBL	L800-TT-MW-12-F01R6	L800-TT-MW-13-FBL	L800-TT-MW13-F01R1	L800-TTMW-13-F01R2	L800-TTMW-13-F01R2-FD	L800-TTMW-13-F01R3
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30
					Sample Date	4/6/2007	9/30/2008	4/5/2007	12/6/2007	1/14/2008	1/14/2008	2/20/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**328000**	**263000**	**345000**	**368000**	**348000**	**340000**	**350000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**624000**	**256000**	**512000**	**433000**	**402000**	**387000**	**419000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**3100**	**2000**	**1600**	**7800**	**38500**	**39100**	**70900**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	**190**	**110**	50 U	**110**	50 U	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	50 U	50 U	50 U	***2900***	***2700***	***2700***	50 U
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**36500**	**71400**	**32800**	**46800**	**44000**	**43400**	**36700**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.2 U	**0.22**	0.19 U	**1.5**	**4.4**	**3**	**0.75**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.2 U	0.19 U	0.19 U	**0.21**	0.2 U	0.19 U	0.2 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**0.28**	0.19 U	0.19 U	**0.42**	0.2 U	0.19 U	**0.12 J**
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**0.73**	**0.36**	0.19 U	**0.68**	**0.5**	**0.39**	0.2 U
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.2 U	0.19 U	0.19 U	**1.1**	**1.2**	**0.97**	**0.22**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**2.6**	**3.5**	**0.42**	**4.5**	**5.2**	**3.3**	**1.9**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***7.1***	**1.7**	**1.9**	***37***	***19.8***	***13.6***	***6.2***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	**8350**	**3940**	**643**	**762**	**631**	**630**	136 B
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***892***	**227**	**432**	**370**	**381**	**391**	**412**
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.2 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**51.4**	**1.94**	**6.66**	**3.03**	**2.64**	**2.79**	**2.58**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW13					L800-TT-MW14	
					Sample ID	L800-TTMW-13-F01R3FD	800-TTMW-13-F01R4	L800-TT-MW13-F01R5	L800-TT-MW-13-F01R6	L800-TT-MW-13-F01R6-FD	L800-TT-MW14-FBL	L800-TT-MW14-F01R1
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30
					Sample Date	2/20/2008	3/13/2008	5/22/2008	9/29/2008	9/29/2008	4/6/2007	12/10/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**348000**	**397000**	**288000**	**314000**	**305000**	**408000**	**373000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**392000**	**535000**	**1670000**	**312000**	**302000**	**491000**	**720000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**71200**	**75900**	**4900**	**3100**	**3200**	**1000**	**1100**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	50 U	50 U	**100**	50 U	50 U	**220**	**2700**
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	50 U	50 U	50 U	50 U	50 U	50 U	***4200***
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**36100**	**37100**	**60300**	**48900**	**45700**	**23000**	**20500**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.19 U	0.19 U	**0.15 J**	**0.11 J**	0.19 U	0.2 U	0.2 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**0.96**	**0.47**	**1.7**	**0.093 J**	0.19 U	**0.74**	**2**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.19 U	0.19 U	**1**	**0.23**	0.19 U	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.19 U	0.19 U	***0.42***	0.19 U	0.19 U	**0.21 J**	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.19 U	0.19 U	***0.1 J***	0.19 U	0.19 U	***0.19 J***	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.19 U	0.19 U	***2.1***	**0.18 J**	0.19 U	0.2 U	0.2 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**0.096 J**	0.19 U	***4.5***	**0.33**	0.19 U	0.2 U	0.2 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**0.48**	**0.11 J**	**0.55**	**0.84**	**0.97**	**0.88**	**0.73**
EXPLOSIVES	DNX	DNX	μg/L	--	--	**0.23**	**0.23**	**0.3**	0.19 U	0.19 U	**0.49**	**0.57**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**1.8**	**1.1**	**19.2**	**6.7**	**4.4**	**1.1**	**1.9**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***5.4***	***2.2***	***91.5***	**1.1**	**0.18 J**	***37.2***	***46.9***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.19 U	0.19 U	1.5 U	0.19 U	0.19 U	0.2 U	0.2 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	140 B	**479**	**761**	**585**	**616**	**1590**	**5680**
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	**411**	**391**	**204**	**419**	**433**	***689***	***933***
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.19 U	0.19 U	**0.13 J**	0.19 U	0.19 U	0.2 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**2.62**	**2.69**	**3.24**	**6.34**	**5.67**	**0.73**	**35.4**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW14						L800-TT-MW15
					Sample ID	L800-TTMW-14-F01R2	L800-TTMW-14-F01R3	800-TTMW-14-F01R4	L800-TT-MW14-F01R5	L800-TT-MW-14-F01R6	L800-TT-MW14-01R7	L800-TT-MW-15-FBL
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	10 - 35
					Sample Date	1/15/2008	2/21/2008	3/17/2008	5/23/2008	10/1/2008	3/5/2009	4/5/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**370000**	**400000**	**430000**	**383000**	**310000**	**379000**	**538000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**398000**	**530000**	**566000**	**642000**	**394000**	**407000**	**1180000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**48100**	**77400**	**89500**	**1200**	**2800**	**83400**	**1400**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	**1300**	**2200**	- -	**1400**	**4900**	**3600**	***481000***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	***2100***	50 U	- -	50 U	**160**	**330**	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**36100**	**25400**	**23800**	**39700**	**61400**	**36000**	**29000**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**2.3**	**0.83**	**0.82**	**3.2**	**10.3**	**4.5**	**0.79**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	**0.2**
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.19 U	0.2 U	0.2 U	0.38 U	***0.26***	***0.38***	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.2 U	0.2 U	0.19 U	**0.22**	**0.18 J**	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.19 U	0.2 U	0.2 U	**0.16 J**	**0.91**	**0.3**	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**0.74**	**0.14 J**	**0.25**	**0.5**	**0.64**	0.57 U	**0.4**
EXPLOSIVES	DNX	DNX	µg/L	--	--	**0.62**	**0.42**	0.2 U	**0.53**	**1.4**	**0.72**	**0.25**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**5.5**	**3.5**	**1.9**	**13.9**	**38.6**	**21.6**	**0.64**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***94***	***67.4***	***82.4***	***279***	***446***	***356***	***51.2***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	**1360**	**510**	**2370**	137 B	123 B	**8600**	**1940**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	**443**	**397**	***605***	***748***	**503**	**538**	***4680***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**16.5**	**16.6**	**13.7**	**12**	**1.57**	**4.65**	**2.32**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW15						
					Sample ID	L800-TT-MW15F01R1	L800-TTMW-15-F01R2	L800-TTMW-15-F01R3	800-TTMW-15-F01R4	L800-TT-MW-15-F01R5	L800-TT-MW-15-F01R6	L800-TT-MW15-01R7
					Sample Depth (ft)	10 - 35	10 - 35	10 - 35	10 - 35	10 - 35	10 - 35	10 - 35
					Sample Date	12/17/2007	1/15/2008	2/22/2008	3/18/2008	5/27/2008	9/29/2008	3/5/2009
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**653000**	**610000**	**600000**	**620000**	**600000**	**435000**	**1190000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**1290000**	**1190000**	**1360000**	**857000**	**1220000**	**306000**	**2610000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**95100**	**111000**	**169000**	**135000**	**1500**	**2700**	**980000**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	***406000***	***402000***	***427000***	***438000***	***369000***	***366000***	***162000***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	***3300***	***2900***	50 U	50 U	**890**	**210**	***3900***
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**38700**	**41000**	**35200**	**32400**	**36900**	**29000**	**20700**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	0.19 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**1.4**	**4.4**	**1.4**	**1.6**	**2.6**	**3**	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	**1.3**	0.19 U	0.19 U	**1.4**	**0.35**	**0.45**	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	**0.13 J**	0.19 U	0.19 U	**0.12 J**	0.19 U	0.2 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	***1***	0.19 U	***0.55***	***0.72***	***1.1***	***1.7***	***0.42***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	**0.4**	0.19 U	0.19 U	**0.42**	**0.27**	**0.85**	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	0.19 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	0.19 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	**1.1**	**0.12 J**	**0.19**	**0.83**	**0.8**	***2.3***	**1.2**
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	0.19 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.2 U	**0.54**	0.19 U	**0.11 J**	0.19 U	**0.11 J**	**0.32**
EXPLOSIVES	DNX	DNX	μg/L	--	--	**0.22**	**1.3**	**0.11 J**	**0.15 J**	**0.21**	**0.24**	0.19 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**3**	**2.7**	**0.48**	**2.3**	**1.8**	**6.6**	2.9 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	0.19 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***225***	***76.8***	***138***	***186***	***252***	***387***	***121***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	0.19 U	0.19 U	0.2 U	0.19 U	0.2 U	0.19 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	231 B	**323**	1500 U	750 U	600 U	920 U	***29700***
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***3810***	***3540***	***3900***	***3830***	***3650***	***3410***	***5300***
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	**0.23**	0.19 U	0.19 U	**0.066 J**	**0.053 J**	**0.19 J**	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**65.6**	**67.7**	**68.2**	**74**	**95.2**	**138**	**7.71**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW15		L800-TT-MW16				
					Sample ID	L800-TTMW-15-F01R9	L800-TTMW15-0818	L800-TTMW-16-FBL	L800-TT-MW16F01R1	L800-TTMW-16-F01R2	L800-TTMW-16-F01R3	800-TTMW-16-F01R4
					Sample Depth (ft)	10 - 35	10 - 35	10 - 35	10 - 35	10 - 35	10 - 35	10 - 35
					Sample Date	8/26/2009	8/28/2018	4/5/2007	12/18/2007	1/15/2008	2/21/2008	3/18/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	**413000**	**488000**	**353000**	**480000**	**480000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	**922000**	**611000**	**368000**	**614000**	**693000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**616000**	- -	510 B	**57000**	**64700**	**92900**	**109000**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	**300**	***40600***	***13800***	***13300***	***16800***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	50 U	***2700***	***2300***	50 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	**23700**	**40700**	**33200**	**27700**	**28600**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	3.8 U	0.1 U	0.19 U	0.19 U	0.2 U	0.2 U	**0.066 J**
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	0.1 U	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	3.8 U	**0.69**	0.19 U	**8.1**	**2**	**0.63**	**4**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	***8.1***	0.1 U	0.19 U	0.19 U	**1.9**	0.2 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	3.8 U	0.1 U	0.19 U	0.19 U	**0.16 J**	0.2 U	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	3.8 U	0.1 U	0.19 U	***1.2***	***1.1***	0.2 U	***0.53***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	***3 J***	0.1 U	0.19 U	**0.11 J**	**0.48**	0.2 U	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	3.8 U	0.21 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	3.8 U	0.21 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	***7.4***	0.1 U	0.19 U	**0.66**	**1.1**	0.2 U	**0.3**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	3.8 U	0.21 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	3.8 U	0.21 U	0.19 U	**0.74**	0.2 U	0.2 U	**0.32**
EXPLOSIVES	DNX	DNX	µg/L	--	--	3.8 U	**0.11 J**	0.19 U	**1.7**	**0.28**	**0.17 J**	**0.82**
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	11 U	**0.29**	0.19 U	**10.9**	**3.4**	**0.8**	**6.2**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	3.8 U	0.1 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***204***	***23***	**1**	***538***	***257***	***3.4***	***192***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	3.8 U	0.1 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	139 B	**2310**	15 U	600 U	15 U
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	- -	***689***	***836***	***716***	***729***	***729***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	3.8 U	- -	0.19 U	0.19 U	**0.18 J**	0.2 U	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	**9.23**	**2.59**	**3.44**	**3.1**	**2.91**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW16					L800-TT-MW17	
					Sample ID	L800-TT-MW-16-F01R5	L800-TT-MW-16-F01R6	L800-TT-MW16-01R7	L800-TT-MW16-F01R7	L800-TT-MW-16-F01R9	L800-TT-MW17-FBL	L800-TT-MW17-F01R1
					Sample Depth (ft)	10 - 35	10 - 35	10 - 35	10 - 35	10 - 35	5 - 30	5 - 30
					Sample Date	5/27/2008	9/29/2008	3/6/2009	3/10/2009	8/26/2009	4/6/2007	12/6/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	**500000**	**442000**	**1400000**	- -	- -	**177000**	**160000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	**674000**	**440000**	**300000**	- -	- -	**270000**	**247000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	**1300**	**1900**	**196000**	- -	**58100**	**2200**	**8700**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	***20600***	***30100***	**1400**	- -	- -	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	50 U	50 U	**580**	- -	- -	50 U	***2100***
ANIONS	14808-79-8	Sulfate	µg/L	--	--	**30600**	**34800**	**15800**	- -	- -	**63100**	**58100**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	**9120000**	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	**6150000**	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	**1940000**	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	**1660000**	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	**7.1**	**11.6**	0.19 U	- -	0.19 U	0.2 U	**0.25**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.2 U	**0.081 J**	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	***1.1***	***1.8***	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	**0.13 J**	**0.17 J**	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	**0.59**	**0.93**	0.57 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**0.31**	**0.28**	**17.2**	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	**1.2**	**1.5**	0.19 U	- -	3 U	0.2 U	0.21 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**10.8**	**17.3**	3.8 U	- -	0.19 U	**1.5**	**0.52**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	0.2 U	0.21 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	***334***	***439***	***31.3***	- -	0.19 U	***6.7***	***28***
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	0.2 U	0.21 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	15 U	23 U	***82200***	- -	- -	**3480**	**4730**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	***730***	***867***	***13500***	- -	- -	**231**	**189**
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	0.2 U	0.19 U	0.19 U	- -	0.19 U	0.2 U	0.21 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	**1.96**	**2.37**	**3.57**	- -	- -	**36.7**	**49.3**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW17					L800-TT-MW18	
					Sample ID	L800-TTMW-17-F01R2	L800-TTMW-17-F01R3	800-TTMW-17-F01R4	L800-TT-MW17-F01R5	L800-TT-MW-17-F01R6	L800-TT-MW18-FBL	L800-TT-MW18-F01R1
					Sample Depth (ft)	5 - 30	5 - 30	5 - 30	5 - 30	5 - 30	7.5 - 27.5	7.5 - 27.5
					Sample Date	1/14/2008	2/19/2008	3/13/2008	5/22/2008	9/30/2008	4/30/2007	12/3/2007
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**145000**	**160000**	**158000**	**129000**	**119000**	**225000**	**265000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**186000**	**461000**	**384000**	**269000**	**192000**	**325000**	**426000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**22800**	**47200**	**45500**	**3300**	**2600**	**2300**	**1900**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	50 U	**140**	50 U	60 B	**150**	***224000***	***252000***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	***1700***	50 U	50 U	50 U	50 U	**930**	***2500***
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**47700**	**51200**	**52400**	**49900**	**47400**	**39100**	**36800**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.2 U	**1.5**
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.2 U	0.2 U	**0.24**	**0.32**	**0.3**	**3.6**	**5.5**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	**0.16 J**	**0.13 J**
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.2 U	0.2 U	***0.1 J***	***0.14 J***	***0.17 J***	***4***	***4.4***
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	**0.19 J**	**0.19 J**
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	***0.46***	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	**1.6**	**1.8**
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	0.2 U	0.2 U	0.19 U	0.19 U	**0.13 J**	**43.5**	**63.2**
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.2 U	0.2 U	**0.095 J**	0.19 U	0.19 U	**2.3**	**3.7**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	0.2 U	**0.29**	**0.89**	**0.93**	**1.1**	**2.3**	0.2 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***3.9***	***4.7***	***22.3***	***32.9***	***33.4***	***843***	***734***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	**813**	**3210**	**3330**	**1500**	**2390**	**764**	122 B
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	**150**	**187**	**190**	**159**	**146**	**129**	**181**
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.2 U	0.2 U	0.19 U	0.19 U	0.19 U	**2.2**	**2.7**
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**19.2**	**40.7**	**5.17**	**18**	**22.8**	**16**	**114**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW18						
					Sample ID	L800-TTMW-18-F01R2	L800-TT-MW18-F01R3	800-TTMW-18-F01R4	L800-TT-MW18-F01R5	L800-TT-MW-18-F01R6	L800-TT-MW18-01R7	L800-TT-MW18-F01R7
					Sample Depth (ft)	7.5 - 27.5	7.5 - 27.5	7.5 - 27.5	7.5 - 27.5	7.5 - 27.5	7.5 - 27.5	7.5 - 27.5
					Sample Date	1/9/2008	2/15/2008	3/12/2008	5/28/2008	10/1/2008	3/9/2009	3/10/2009
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**236000**	**150000**	**260000**	**210000**	**224000**	**1450000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**251000**	**188000**	**401000**	**364000**	**310000**	**2700000**	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**37100**	**43500**	**56600**	**2200**	**2600**	**13400**	- -
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	***297000***	***246000***	***243000***	***222000***	***205000***	**4800**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	***2300***	**950**	***1100***	**1000**	***1400***	***9000***	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**36900**	**37800**	**40100**	**40900**	**47300**	**4800**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	**11100000**
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	**6630000**
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	**839000**
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	**151000**
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	**1.7 J**	**1.6**	0.19 U	2 U	**0.87**	0.19 U	- -
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**6**	**5.8**	**7.1**	**7.7**	**15**	0.19 U	- -
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	2 U	1 U	0.19 U	2 U	0.19 U	0.19 U	- -
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	2 U	1 U	**0.13 J**	2 U	**0.21**	0.19 U	- -
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	***5.2***	***4.5***	***4.7***	***4.4***	***5.1***	0.19 U	- -
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	2 U	1 U	**0.22**	2 U	**0.46**	0.19 U	- -
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	2 U	1 U	0.19 U	2 U	***0.43***	0.19 U	- -
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	2 U	1 U	0.19 U	2 U	0.19 U	0.19 U	- -
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	***2.2***	***2.4***	***2***	***2.1***	***2.6***	0.19 U	- -
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	2 U	1 U	0.19 U	2 U	0.19 U	0.19 U	- -
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**73.2**	**66.8**	**93.6**	**62.7**	**72.9**	**15.4**	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	**4.5**	**4**	**5.3**	**4.6**	**5**	0.19 U	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**3.7**	**1.8**	**3.8**	**2.6**	**2.5**	1.3 U	- -
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	2 U	1 U	0.19 U	2 U	0.19 U	0.19 U	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***644***	***701***	***794***	***717***	***1030***	***12.3***	- -
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	2 U	1 U	0.19 U	2 U	0.19 U	0.19 U	- -
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	15 U	15 U	108 B	600 U	54.7 B	***71900***	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	**118**	**97.1**	**136**	**121**	**123**	***10300***	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	**2.5**	**2.5**	**2.7**	**3**	**2.9**	0.19 U	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**72.6**	**108**	**108**	**106**	**211**	**16.3**	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TT-MW18	L800-TT-MW19R					
					Sample ID	L800-TTMW18-0818	L800-TT-MW19R-FBL	L800-TT-MW19R-F01R1	L800-TTMW-19R-F01R2	L800-TTMW-19R-F01R3	800-TTMW-19R-F01R4	L800-TT-MW19R-F01R5
					Sample Depth (ft)	7.5 - 27.5	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25
					Sample Date	8/29/2018	9/24/2007	12/17/2007	1/15/2008	2/21/2008	3/19/2008	5/28/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	**400000**	**788000**	**485000**	**508000**	**460000**	**465000**
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	**562000**	**1450000**	**694000**	**1050000**	**636000**	**724000**
GENERAL	14797-73-0	Perchlorate	µg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	**1900**	**156000**	**73900**	**102000**	**84400**	**3100**
GENERAL	1011	Specific conductance	µS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	**270**	**1600**	**260**	50 U	50 U	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	50 U	***8100***	***3800***	50 U	50 U	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	**19200**	**8700**	**15800**	**17100**	**18000**	**12300**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	µg/L	590	--	0.1 UJ	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 UJ
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	µg/L	2	--	0.1 UJ	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.1 UJ	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	µg/L	2.5	--	0.1 UJ	***11.5***	0.19 U	**0.72**	**0.11 J**	0.2 U	0.2 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	µg/L	0.24	--	0.1 UJ	***2.1***	0.19 U	***0.25***	**0.22**	**0.17 J**	0.2 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	µg/L	0.049	--	0.1 UJ	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	µg/L	1.9	--	0.1 UJ	***87***	***2.8***	***20.5***	***15***	***15.6***	**0.81**
EXPLOSIVES	88-72-2	2-Nitrotoluene	µg/L	0.31	--	0.21 UJ	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	µg/L	1.7	--	0.21 UJ	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	µg/L	1.9	--	0.1 UJ	***41.3***	**1.4**	***7.9***	***6.7***	***5.9***	**0.5**
EXPLOSIVES	99-99-0	4-Nitrotoluene	µg/L	4.3	--	0.21 UJ	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	13980-04-6	TNX	µg/L	--	--	**0.27 J**	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	0.1 UJ	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	**0.084 J**	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	**3.2**
EXPLOSIVES	98-95-3	Nitrobenzene	µg/L	0.14	--	***0.43 J***	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	**1.3 J**	***4.9***	0.19 U	**1.3**	**0.69**	**0.84**	**0.24**
EXPLOSIVES	479-45-8	Tetryl	µg/L	39	--	0.1 UJ	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
METALS	7440-38-2	Arsenic	µg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	µg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	µg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	µg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	15 U	***25300***	**11600**	**10800**	**8280**	**10500**
METALS	7439-92-1	Lead	µg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	579.7	- -	***680***	***7270***	***2670***	***2460***	***1990***	***2960***
METALS	7439-97-6	Mercury	µg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	µg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	µg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	µg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	µg/L	--	--	- -	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	µg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	µg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	**45.7**	**36.2**	**67**	**62.2**	**252**
VOLATILES	108-10-1	Methyl isobutyl ketone	µg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	µg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TTPZ-20	L800-TTPZ-21		L800-TTPZ-22	L800-TTPZ-23	L800-TTPZ-24	L800-TTPZ-25R
					Sample ID	L800-TTPZ-20-F01R6	L800-TTPZ-21-F01R6	L800-TTPZ-21-F01R9	L800-TTPZ-22-F01R6	L800-TTPZ-23-F01R6	L800-TTPZ-24-F01R6	L800-TTPZ-25R-F01R6
					Sample Depth (ft)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
					Sample Date	10/22/2008	10/22/2008	8/28/2009	10/22/2008	10/17/2008	10/15/2008	11/21/2008
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**							
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**488000**	**769000**	- -	**152000**	**263000**	**191000**	**357000**
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**544000**	**1000000**	- -	**263000**	**380000**	**198000**	**435000**
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**92500**	**2500**	**1300**	**7100**	**3100**	**5800**	**3600**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	**9700**	***20500***	- -	50 U	***118000***	***174000***	***28100***
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	***4100***	50 U	- -	50 U	***1300***	***2600***	***4400***
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**67900**	**32400**	- -	**59100**	**67600**	**177000**	**12700**
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	0.19 U	0.19 U	0.19 U	0.19 U	3.8 U	**13.2 J**	0.19 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	0.19 U	**7.5**	**1.9**	0.19 U	**29.1**	**145**	0.19 U
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	0.19 U	**1.7**	0.19 U	0.19 U	3.8 U	38 U	0.19 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	0.19 U	***1.5***	0.19 U	0.19 U	***4.9***	***82.1***	0.19 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	0.19 U	***1.9***	***0.12 J***	0.19 U	***7.9***	***28 J***	0.19 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	0.19 U	***4.7***	**0.21**	0.19 U	3.8 U	***74.1***	0.19 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	0.19 U	0.19 U	0.19 U	0.19 U	3.8 U	38 U	0.19 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	0.19 U	0.19 U	0.19 U	0.19 U	3.8 U	38 U	0.19 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	0.19 U	***9.1***	**0.48**	0.19 U	***14.3***	***138***	0.19 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	0.19 U	0.19 U	0.19 U	0.19 U	3.8 U	38 U	0.19 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	**0.19**	**1.5**	**0.48**	0.19 U	**214**	**722**	0.19 U
EXPLOSIVES	DNX	DNX	μg/L	--	--	0.19 U	**2.1**	**0.42**	0.19 U	**16.8**	**89.8**	0.19 U
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**0.72**	**103**	**8**	0.19 U	**20.7**	**320**	0.19 U
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	0.19 U	0.19 U	0.19 U	0.19 U	3.8 U	38 U	0.19 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***15***	***551***	***57.2***	0.19 U	***1350***	***3790***	0.19 U
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	0.19 U	0.19 U	0.19 U	0.19 U	3.8 U	38 U	**0.95**
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	**2730**	182 B	- -	**435**	**318**	184 B	**1480**
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***3030***	***1580***	- -	**225**	**234**	**150**	***1510***
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	0.19 U	**0.72**	0.19 U	0.19 U	**3.8**	**21.7 J**	0.19 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**15.9**	**1.23**	- -	**398**	**142**	**89.1**	**60.5**
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -	- -	- -	- -

Table 5.7-6. Detected Chemicals in Groundwater—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, IA

					Location	L800-TTPZ-26		L800-TTPZ-27	
					Sample ID	L800-TTPZ-26-F01R6	L800-TTPZ-26-F01R9	L800-TTPZ-27-F01R6	L800-TTPZ-27-F01R9
					Sample Depth (ft)	Unknown	Unknown	Unknown	Unknown
					Sample Date	10/28/2008	9/2/2009	10/28/2008	9/2/2009
Test Group	**CAS**	**Analyte**	**Unit**	**Screening Level***	**Background Threshold Value (UTL95-95[1])**				
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	**226000**	- -	**156000**	- -
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	**383000**	- -	**214000**	- -
GENERAL	14797-73-0	Perchlorate	μg/L	15	--	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	**10300**	**3500**	**3300**	**2900**
GENERAL	1011	Specific conductance	μS/cm	--	--	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	μg/L	--	--	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	**4600**	- -	**1400**	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	**200**	- -	50 U	- -
ANIONS	14808-79-8	Sulfate	μg/L	--	--	**49900**	- -	**66800**	- -
BACTERIA	TOTBAC	All Bacteria	cells/mL	--	--	- -	- -	- -	- -
BACTERIA	ARCHEA	Archea	cells/mL	--	--	- -	- -	- -	- -
BACTERIA	PROTEOBACT	Delta Proteobacteria	cells/mL	--	--	- -	- -	- -	- -
BACTERIA	PSDMO	Pseudomonas	cells/mL	--	--	- -	- -	- -	- -
EXPLOSIVES	99-35-4	1,3,5-Trinitrobenzene	μg/L	590	--	38 U	40 U	19 U	9.6 U
EXPLOSIVES	99-65-0	1,3-Dinitrobenzene	μg/L	2	--	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	**33 J**	**38.1 J**	**16 J**	**13.1**
EXPLOSIVES	118-96-7	2,4,6-Trinitrotoluene	μg/L	2.5	--	***547***	***1040***	19 U	9.6 U
EXPLOSIVES	121-14-2	2,4-Dinitrotoluene	μg/L	0.24	--	***28.4 J***	***50.4***	19 U	9.6 U
EXPLOSIVES	606-20-2	2,6-Dinitrotoluene	μg/L	0.049	--	38 U	40 U	19 U	9.6 U
EXPLOSIVES	35572-78-2	2-Amino-4,6-dinitrotoluene	μg/L	1.9	--	***107***	***189***	19 U	9.6 U
EXPLOSIVES	88-72-2	2-Nitrotoluene	μg/L	0.31	--	38 U	40 U	19 U	9.6 U
EXPLOSIVES	99-08-1	3-Nitrotoluene	μg/L	1.7	--	38 U	40 U	19 U	9.6 U
EXPLOSIVES	19406-51-0	4-Amino-2,6-dinitrotoluene	μg/L	1.9	--	***203***	***186***	***9.6 J***	9.6 U
EXPLOSIVES	99-99-0	4-Nitrotoluene	μg/L	4.3	--	38 U	40 U	19 U	9.6 U
EXPLOSIVES	13980-04-6	TNX	μg/L	--	--	38 U	40 U	19 U	**3.3 J**
EXPLOSIVES	DNX	DNX	μg/L	--	--	38 U	40 U	19 U	**2.4 J**
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	**647**	**697**	**148**	**56.8**
EXPLOSIVES	98-95-3	Nitrobenzene	μg/L	0.14	--	38 U	40 U	19 U	9.6 U
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	***2860***	***3130***	***1290***	***592***
EXPLOSIVES	479-45-8	Tetryl	μg/L	39	--	38 U	40 U	19 U	9.6 U
METALS	7440-38-2	Arsenic	μg/L	10	33.3	- -	- -	- -	- -
METALS	7440-39-3	Barium	μg/L	2000	430	- -	- -	- -	- -
METALS	7440-43-9	Cadmium	μg/L	5	5	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -
METALS	7440-47-3	Chromium	μg/L	100	31	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	23 U	- -	23 U	- -
METALS	7439-92-1	Lead	μg/L	15	18.05	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	579.7	***594***	- -	**221**	- -
METALS	7439-97-6	Mercury	μg/L	2	1	- -	- -	- -	- -
METALS	7782-49-2	Selenium	μg/L	50	10	- -	- -	- -	- -
METALS	7440-22-4	Silver	μg/L	130	10	- -	- -	- -	- -
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -
METALS	7440-66-6	Zinc	μg/L	6000	789	- -	- -	- -	- -
SEMIVOLATILES	15980-15-1	1,4-Oxathiane	μg/L	--	--	**31.2 J**	**57.9**	19 U	9.6 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	- -	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -
VOLATILES	107-06-2	1,2-Dichloroethane	μg/L	5	--	- -	- -	- -	- -
VOLATILES	540-59-0	1,2-Dichloroethene (total)	μg/L	--	--	- -	- -	- -	- -
VOLATILES	591-78-6	2-Hexanone	μg/L	38	--	- -	- -	- -	- -
VOLATILES	156-59-2	cis-1,2-Dichloroethene	μg/L	70	--	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	**33.7**	- -	**0.87**	- -
VOLATILES	108-10-1	Methyl isobutyl ketone	μg/L	6300	--	- -	- -	- -	- -
VOLATILES	127-18-4	Tetrachloroethene	μg/L	5	--	- -	- -	- -	- -
VOLATILES	109-99-9	Tetrahydrofuran	μg/L	3400	--	- -	- -	- -	- -
VOLATILES	108-88-3	Toluene	μg/L	1000	--	- -	- -	- -	- -
VOLATILES	79-01-6	Trichloroethene	μg/L	5	--	- -	- -	- -	- -

Notes:
DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane
RDX = 1,3,5-trinitro-1,3,5-triazine
TNX = 1,5-anhydro-2-deoxy-2-(ethanethioylamino)-D-arabino-hex-1-enitol
B = The analyte was detected in the associated method and/or calibration blank.
D = Diluted sample.
E = Sample result over the calibration range, considered an estimated result.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
N = The analysis indicates the presence of an analyte for which there was presumptive evidence to make a tentative identification.
P = Sample failed confirmation precision criteria.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
NA = Not analyzed
µg/L = micrograms per liter
µS/cm = microSiemens per centimeter
cells/mL = cells per milliliter
Bold indicates the analyte was detected
Italics indicates the result exceeded screening criteria
Shading indicates the result exceeded screening criteria and background value, if applicable.
*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.
MCL = Maximum Contaminant Level
Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.
Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.
Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M 2020a)
[1] UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.7-7. Groundwater Quality Parameters—Line 800

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (uS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
800-MW27	8/28/2018	11.46	7.29	15.4	640	64.4	3.14	8.57
800-MW28	8/27/2018	11.17	7.92	26.92	3160	-13.9	4.47	4.05
800-MW29	8/28/2018	13.19	6.86	15.92	506	-108	0.07	10.8
800-MW30	8/28/2018	13.45	7.19	18.14	523	-29.6	0.44	0.94
800-MW31	8/27/2018	11.35	7.33	15.72	3280	7.8	1.71	193
G-17	8/19/2018	14.35	6.98	15	455	38.4	7.19	87.8
G-20	8/28/2018	13.09	6.91	18	912	-12.8	0.42	1.36
G-40	5/31/2018	46	8.57	19	236	-199.1	0.08	573
G-43	8/29/2018	22.49	7.1	12.9	532	-27.7	0.19	49.4
G-45	8/27/2018	12.72	7.13	21.1	540	99.7	1.28	5.14
G-47	8/19/2018	10.68	7.15	19.32	597	63	0.68	2.9
G-47	4/24/2018	5.72	7.03	11.29	663	201.3	2.31	3.02
G-56	8/29/2018	9.59	6.57	14.68	813	-48	2.53	18
G-58	8/27/2018	11.39	6.5	21.7	750	191.8	1.48	6.75
800-MW-1	8/18/2018	11.17	7.11	19.54	667	149	3.35	5.89
800-MW-1	8/21/2018	11.17	6.86	15.77	679	177	2.61	0
800-MW-4	8/19/2018	20.33	6.75	14.16	778	142	2.88	7.5
800-MW-7	8/19/2018	10.84	6.95	14.2	667	27	0.57	1.2
800-MW-8	8/19/2018	9.45	6.88	16.5	333	115.7	0.3	0
800-MW-8	8/21/2018	9.45	6.45	15.75	450	172	0.68	0
800-MW-9	8/18/2018	10.25	6.81	20.98	492	129	0.64	4.44
800-MW-12	8/18/2018	11.4	7.19	24.34	472	105	1.97	2.13
800-MW-13	8/19/2018	11.6	7.17	16.8	308	68.8	0.26	9.71
800-MW-14	8/20/2018	12.02	6.8	14.91	1060	163	9.45	22.1
800-MW-15	8/19/2018	11	6.73	15.7	418	145.4	1.19	3.53
800-MW-18	8/18/2018	9.95	6.81	16.9	337	173.8	0.94	5.32
800-MW-20	8/28/2018	14.57	6.95	17.2	541	227.7	2.9	4.75
800-MW-25	8/18/2018	10.05	6.73	15.8	540	176	0.28	3.85
800-MW-25	8/20/2018	10.05	6.5	17.02	796	115	0.77	0
800-MW-26	8/19/2018	10.25	6.55	18.5	366	170.9	0.32	8.59
L800-TT-MW01	8/29/2018	7.4	6.15	14.7	521	100.8	3.31	99.3
L800-TT-MW04	8/28/2018	7.23	6.35	13.3	780	53.5	0.22	54.5

Table 5.7-7. Groundwater Quality Parameters—Line 800

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (uS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
L800-TT-MW09	8/28/2018	8.87	6.07	13.5	650	141	0.15	61.8
L800-TT-MW15	8/28/2018	18.82	6.41	15	2310	231.8	2.17	24.3
L800-TT-MW18	8/29/2018	8.44	6.82	13.6	1070	-79.2	0.18	3.08

Notes:

Water quality parameters were measured in the field using a YSI multi-meter.

°C = degrees Celsius

DO = dissolved oxygen

mV = millivolt(s)

NTU = nephelometric turbidity unit

ORP = oxidation-reduction potential

ug/L = microgram(s) per liter

uS/cm = microsiemen(s) per centimeter

ft = feet

btoc = below top of casing

Table 5.7-9. Data Groupings Used in the HHRA—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Description	Sample Count
AOC_GW	Groundwater for all of Line 800 and Pinkwater Lagoon	177
AOC_GW-CW	Shallow Groundwater (DTW ≤ 10 feet bgs in trench/culvert	34
AOC_GW_RDX Plume	Groundwater samples collected from the core of the RDX Plume.	112

Note:

bgs - below ground surface

DTW - depth to water

Table 5.7-10. Samples Used in the HHRA—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected (2)	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW		AOC_GW-Plume	WG	800-MW-1	800-MW-1-20040618	6/18/2004	9.9	19.9
AOC_GW		AOC_GW-Plume	WG	800-MW-1	F04-GW-043	11/15/2004	9.9	19.9
AOC_GW		AOC_GW-Plume	WG	800-MW-1	L800-MW1-0818	8/18/2018	9.9	19.9
AOC_GW			WG	800-MW-10	800-MW-10-20040607	6/7/2004	7.5	17.5
AOC_GW			WG	800-MW-10	F04-GW-022	11/12/2004	7.5	17.5
AOC_GW			WG	800-MW-10	800-MW-10-FBL	3/20/2007	7.5	17.5
AOC_GW			WG	800-MW-11	800-MW-11-20040607	6/7/2004	66.2	76.2
AOC_GW			WG	800-MW-12	800-MW-12-20040607	6/7/2004	7.5	17.5
AOC_GW			WG	800-MW-12	L800-MW12-0818	8/18/2018	7.5	17.5
AOC_GW			WG	800-MW-13	800-MW-13-20040608	6/8/2004	7.5	17.5
AOC_GW			WG	800-MW-13	F04-GW-044	11/15/2004	7.5	17.5
AOC_GW			WG	800-MW-13	L800-MW13-0818	8/19/2018	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-14	800-MW-14-20040621	6/21/2004	25	35
AOC_GW		AOC_GW-Plume	WG	800-MW-14	L800-MW14-0818	8/20/2018	25	35
AOC_GW			WG	800-MW-15	800-MW-15-20040608	6/8/2004	7.5	17.5
AOC_GW			WG	800-MW-15	L800-MW15-0818	8/19/2018	7.5	17.5
AOC_GW			WG	800-MW-16	800-MW-16-20040618	6/18/2004	60.5	70.5
AOC_GW			WG	800-MW-17	800-MW-17-20040619	6/19/2004	24.5	34.5
AOC_GW	AOC_GW-CW		WG	800-MW-18	800-MW-18-20040620	6/20/2004	7.5	17.5
AOC_GW	AOC_GW-CW		WG	800-MW-18	F04-GW-005	11/10/2004	7.5	17.5
AOC_GW	AOC_GW-CW		WG	800-MW-18	L800-MW18-0818	8/18/2018	7.5	17.5
AOC_GW			WG	800-MW-19	800-MW-19-20040619	6/19/2004	64	74
AOC_GW		AOC_GW-Plume	WG	800-MW-2	800-MW-2-20040621	6/21/2004	66	76
AOC_GW		AOC_GW-Plume	WG	800-MW-2	800MW-2	5/19/2005	66	76
AOC_GW		AOC_GW-Plume	WG	800-MW-2	800-MW2-150605	6/15/2005	66	76
AOC_GW		AOC_GW-Plume	WG	800-MW-2	MW-02-01R2	7/13/2005	66	76
AOC_GW		AOC_GW-Plume	WG	800-MW-2	MW02-01R3	8/25/2005	66	76
AOC_GW		AOC_GW-Plume	WG	800-MW-2	MW-02-01R4	11/8/2005	66	76
AOC_GW			WG	800-MW-20	800-MW-20-20040621	6/21/2004	7.5	17.5
AOC_GW			WG	800-MW-20	F04-GW-007	11/11/2004	7.5	17.5
AOC_GW			WG	800-MW-20	L800-MW20-0818	8/28/2018	7.5	17.5
AOC_GW			WG	800-MW-21	800-MW-21-20040619	6/19/2004	67	77
AOC_GW		AOC_GW-Plume	WG	800-MW-22	800-MW-22-20040615	6/15/2004	54	64
AOC_GW			WG	800-MW-23	800MW23	6/6/2004	54	64
AOC_GW			WG	800-MW-24	800MW24	6/7/2004	67	77
AOC_GW		AOC_GW-Plume	WG	800-MW-25	800-MW-25-20040621	6/21/2004	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-25	F04-GW-024	11/12/2004	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-25	800-MW-25-01R7	3/9/2009	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-25	800-MW-25-F01R9	8/28/2009	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-25	L800-MW25-0818	8/18/2018	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-26	800-MW-26-20040615	6/15/2004	7	17
AOC_GW		AOC_GW-Plume	WG	800-MW-26	F04-GW-016	11/11/2004	7	17
AOC_GW		AOC_GW-Plume	WG	800-MW-26	800-MW-26-01R7	3/9/2009	7	17

Table 5.7-10. Samples Used in the HHRA—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected (2)	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW		AOC_GW-Plume	WG	800-MW-26	800-MW-26-F01R9	8/27/2009	7	17
AOC_GW		AOC_GW-Plume	WG	800-MW-26	L800-MW26-0818	8/19/2018	7	17
AOC_GW		AOC_GW-Plume	WG	800-MW27	L800-MW27-0818	8/29/2018	13	22.5
AOC_GW			WG	800-MW28	L800-MW28-0818	8/27/2018	13	22.5
AOC_GW			WG	800-MW29	L800-MW29-0818	8/28/2018	13	22.5
AOC_GW		AOC_GW-Plume	WG	800-MW-3	800-MW-3-20040619	6/19/2004	69	79
AOC_GW			WG	800-MW30	L800-MW30-0818	8/28/2018	13	22.5
AOC_GW		AOC_GW-Plume	WG	800-MW31	L800-MW31-0818	8/28/2018	13	22.5
AOC_GW		AOC_GW-Plume	WG	800-MW-4	800-MW-4-20040618	6/18/2004	64	74
AOC_GW		AOC_GW-Plume	WG	800-MW-4	L800-MW4-0818	8/19/2018	64	74
AOC_GW			WG	800-MW-5	800-MW-5-20040617	6/17/2004	7.5	17.5
AOC_GW			WG	800-MW-5	F04-GW-013	11/11/2004	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-6	800-MW-6-20040620	6/20/2004	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-6	F04-GW-039	11/15/2004	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-6	800-MW-6-01R7	3/3/2009	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-6	L800-MW-6-F01R9	8/26/2009	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	800-MW-7	800-MW-7-20040618	6/18/2004	27.5	37.5
AOC_GW		AOC_GW-Plume	WG	800-MW-7	L800-MW7-0818	8/19/2018	27.5	37.5
AOC_GW	AOC_GW-CW		WG	800-MW-8	800-MW-8-20040606	6/6/2004	7.5	17.5
AOC_GW	AOC_GW-CW		WG	800-MW-8	F04-GW-045	11/15/2004	7.5	17.5
AOC_GW	AOC_GW-CW		WG	800-MW-8	L800-MW8-0818	8/19/2018	7.5	17.5
AOC_GW			WG	800-MW-9	800-MW-9-20040606	6/6/2004	7.5	17.5
AOC_GW			WG	800-MW-9	L800-MW9-0818	8/18/2018	7.5	17.5
AOC_GW		AOC_GW-Plume	WG	G-17	G-17-20040609	6/9/2004	9	19
AOC_GW		AOC_GW-Plume	WG	G-17	F04-GW-023	11/12/2004	9	19
AOC_GW		AOC_GW-Plume	WG	G-17	L800-G17-0818	8/19/2018	9	19
AOC_GW		AOC_GW-Plume	WG	G-18	G-18-20040616	6/16/2004	9	19
AOC_GW		AOC_GW-Plume	WG	G-18	G-18	5/19/2005	9	19
AOC_GW		AOC_GW-Plume	WG	G-18	G-18-160605	6/16/2005	9	19
AOC_GW		AOC_GW-Plume	WG	G-18	G18-01R2	7/13/2005	9	19
AOC_GW		AOC_GW-Plume	WG	G-18	G-18-01R3	8/25/2005	9	19
AOC_GW		AOC_GW-Plume	WG	G-18	G-18-01R4	11/8/2005	9	19
AOC_GW		AOC_GW-Plume	WG	G-18	G-18-FBL	3/20/2007	9	19
AOC_GW		AOC_GW-Plume	WG	G-19	G-19-20040616	6/16/2004	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-19	G-19-01R7	3/5/2009	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-19	G-19-F01R7	3/6/2009	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-19	G-19-F01R9	8/28/2009	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-20	G-20-20040616	6/16/2004	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-20	G-20-20040618	6/18/2004	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-20	F04-GW-047	11/16/2004	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-20	G-20-01R7	3/4/2009	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-20	G-20-F01R7	3/5/2009	9.5	19.5
AOC_GW		AOC_GW-Plume	WG	G-20	L800-G20-0818	8/28/2018	9.5	19.5

Table 5.7-10. Samples Used in the HHRA—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected (2)	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW			WG	G-40	G-40-20040607	6/7/2004	73.25	83.25
AOC_GW			WG	G-40	G-40-0518	5/31/2018	73.25	83.25
AOC_GW	AOC_GW-CW		WG	G-41	G-41-20040606	6/6/2004	9.8	19.8
AOC_GW	AOC_GW-CW		WG	G-41	G-41-FBL	3/19/2007	9.8	19.8
AOC_GW			WG	G-42	G-42-20040607	6/7/2004	66.5	76.5
AOC_GW			WG	G-43	G-43-20040607	6/7/2004	32.1	42.1
AOC_GW			WG	G-43	L800-G-43-0818	8/29/2018	32.1	42.1
AOC_GW			WG	G-44	G-44-20040617	6/17/2004	68	78
AOC_GW			WG	G-45	G-45-20040617	6/17/2004	30	40
AOC_GW			WG	G-45	G-45-0818	8/27/2018	30	40
AOC_GW			WG	G-46	G-46-20040606	6/6/2004	58	68
AOC_GW			WG	G-47	G-47-20040606	6/6/2004	16	26
AOC_GW			WG	G-47	G47-0418	4/24/2018	16	26
AOC_GW			WG	G-48	G-48-20040605	6/5/2004	20	30
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	G-56	G-56-20040615	6/15/2004	18.5	28.51
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	G-56	F04-GW-017	11/11/2004	18.5	28.51
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	G-56	G-56-01R7	3/5/2009	18.5	28.51
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	G-56	G-56-F01R7	3/6/2009	18.5	28.51
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	G-56	G-56-F01R9	8/26/2009	18.5	28.51
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	G-56	L800-G56-0818	8/20/2018	18.5	28.51
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	G-57	G-57-20040615	6/15/2004	19.95	29.96
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	G-57	G-57-01R7	3/5/2009	19.95	29.96
AOC_GW		AOC_GW-Plume	WG	G-58	G-58-20040616	6/16/2004	20	30
AOC_GW		AOC_GW-Plume	WG	G-58	G-58-01R7	3/3/2009	20	30
AOC_GW		AOC_GW-Plume	WG	G-58	G-58-F01R9	8/25/2009	20	30
AOC_GW		AOC_GW-Plume	WG	G-58	L800-G-58-0818	8/27/2018	20	30
AOC_GW			WG	JAW-78	JAW-78-20040606	6/6/2004	50	65
AOC_GW	AOC_GW-CW		WG	JAW-79	JAW-79-20040606	6/6/2004	25	35
AOC_GW	AOC_GW-CW		WG	L800-TT-MW01	800-TT-MW1	5/16/2005	1	6.4
AOC_GW	AOC_GW-CW		WG	L800-TT-MW01	800-TT-MW01-150605	6/15/2005	1	6.4
AOC_GW	AOC_GW-CW		WG	L800-TT-MW01	L800-TT-MW1-01R2	7/15/2005	1	6.4
AOC_GW	AOC_GW-CW		WG	L800-TT-MW01	L800-TT-MW1-01R3	8/26/2005	1	6.4
AOC_GW	AOC_GW-CW		WG	L800-TT-MW01	L800-TT-MW1-01R4	11/8/2005	1	6.4
AOC_GW	AOC_GW-CW		WG	L800-TT-MW01	L800-TTMW01-0818	8/29/2018	1	6.4
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW02	800-TT-MW2	5/16/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW02	800-TT-MW02-150605	6/15/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW02	L800-TT-MW2-01R2	7/13/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW02	L800-TT-MW2-01R3	8/26/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW02	L800-TT-MW2-01R4	11/7/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW02	L800-TT-MW02-FBL	3/21/2007	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW03	800-TT-MW3	5/16/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW03	800-TT-MW03-150605	6/15/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW03	L800-TT-MW3-01R2	7/15/2005	25	30

Table 5.7-10. Samples Used in the HHRA—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected (2)	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW03	L800-TT-MW3-01R3	8/26/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW03	L800-TT-MW3-01R4	11/7/2005	25	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW03	L800-TT-MW03-FBL	3/21/2007	25	30
AOC_GW	AOC_GW-CW		WG	L800-TT-MW04	800-TT-MW4	5/16/2005	20	25
AOC_GW	AOC_GW-CW		WG	L800-TT-MW04	800-TT-MW04-150605	6/15/2005	20	25
AOC_GW	AOC_GW-CW		WG	L800-TT-MW04	L800-TT-MW4-01R2	7/15/2005	20	25
AOC_GW	AOC_GW-CW		WG	L800-TT-MW04	L800-TT-MW4-01R3	8/26/2005	20	25
AOC_GW	AOC_GW-CW		WG	L800-TT-MW04	L800-TT-MW4-01R4	11/8/2005	20	25
AOC_GW	AOC_GW-CW		WG	L800-TT-MW04	L800-TTMW04-0818	8/29/2018	20	25
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW05	800-TT-MW5	5/16/2005	20	25
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW05	800-TT-MW05-140605	6/14/2005	20	25
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW05	L800-TT-MW5-01R2	7/13/2005	20	25
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW05	L800-TT-MW5-01R3	8/25/2005	20	25
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW05	L800-TT-MW5-01R4	11/7/2005	20	25
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW05	L800-TT-MW05-FBL	3/20/2007	20	25
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW06	L800-TT-MW06-F01R9	8/31/2009	15	25
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW07	L800-TT-MW07-F01R9	9/1/2009	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW08	L800-TT-MW08-F01R9	9/1/2009	5	30
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	L800-TT-MW09	L800-TT-MW09-01R7	3/9/2009	5	30
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	L800-TT-MW09	L800-TTMW09-0818	8/28/2018	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW10	L800-TTMW-10-F01R9	9/2/2009	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW11	L800-TT-MW11-01R7	3/6/2009	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW12	L800-TT-MW-12-F01R6	9/30/2008	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW13	L800-TT-MW-13-F01R6	9/29/2008	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW14	L800-TT-MW14-01R7	3/5/2009	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW15	L800-TT-MW15-01R7	3/5/2009	10	35
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW15	L800-TTMW-15-F01R9	8/26/2009	10	35
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW15	L800-TTMW15-0818	8/28/2018	10	35
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW16	L800-TT-MW16-01R7	3/6/2009	10	35
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW16	L800-TT-MW16-F01R7	3/10/2009	10	35
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW16	L800-TT-MW-16-F01R9	8/26/2009	10	35
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW17	L800-TTMW-17-F01R2	1/14/2008	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW17	L800-TTMW-17-F01R3	2/19/2008	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW17	800-TTMW-17-F01R4	3/13/2008	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW17	L800-TT-MW17-F01R5	5/22/2008	5	30
AOC_GW		AOC_GW-Plume	WG	L800-TT-MW17	L800-TT-MW-17-F01R6	9/30/2008	5	30
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	L800-TT-MW18	L800-TT-MW18-01R7	3/9/2009	7.5	27.5
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	L800-TT-MW18	L800-TT-MW18-F01R7	3/10/2009	7.5	27.5
AOC_GW	AOC_GW-CW	AOC_GW-Plume	WG	L800-TT-MW18	L800-TTMW18-0818	8/29/2018	7.5	27.5
AOC_GW			WG	L800-TT-MW19R	L800-TT-MW19R-F01R5	5/28/2008	5	25
AOC_GW		AOC_GW-Plume	WG	L800-TTPZ-20	L800-TTPZ-20-F01R6	10/22/2008	0	0
AOC_GW		AOC_GW-Plume	WG	L800-TTPZ-21	L800-TTPZ-21-F01R9	8/28/2009	0	0
AOC_GW		AOC_GW-Plume	WG	L800-TTPZ-22	L800-TTPZ-22-F01R6	10/22/2008	0	0

Table 5.7-10. Samples Used in the HHRA—Line 800 and Pinkwater Lagoon

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected (2)	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW		AOC_GW-Plume	WG	L800-TTPZ-23	L800-TTPZ-23-F01R6	10/17/2008	0	0
AOC_GW		AOC_GW-Plume	WG	L800-TTPZ-24	L800-TTPZ-24-F01R6	10/15/2008	0	0
AOC_GW		AOC_GW-Plume	WG	L800-TTPZ-25R	L800-TTPZ-25R-F01R6	11/21/2008	0	0
AOC_GW		AOC_GW-Plume	WG	L800-TTPZ-26	L800-TTPZ-26-F01R9	9/2/2009	0	0
AOC_GW		AOC_GW-Plume	WG	L800-TTPZ-27	L800-TTPZ-27-F01R9	9/2/2009	0	0

Notes:

(1) The data were reduced such that when a normal and duplicate sample were available, the highest detected concentration among normal or duplicate samples was used when a chemical was detected in any sample. If both results were non-detect, the lowest reported detection limit (i.e., reporting limit) was used.

(2) For 2004 samples, only VOC and metals data were evaluated in the HHRA. For 2005 samples, only VOC data were evaluated in the HHRA. For 2009 samples, only metals data were evaluated in the HHRA.

WG = groundwater

Table 5.8-1. Previous Investigations and Remedial Actions—Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Previous Investigations/Actions	Date of Activity	Description	Conclusions/Recommendations
Installation Assessment of IAAAP (USATHAMA 1980)	1980	A records search regarding environmental quality was conducted to assess the use, storage, treatment, and disposal of toxic and hazardous materials at IAAAP.	Line 9 was constructed in 1942, during World War II, as a components production facility. The explosives processed at the facility included TNT, RDX, and PBX, and the solvents included acetone and lacquer thinner. A follow-on preliminary survey was recommended to assess potential soil contamination and potential contaminant migration off the facility.
Sump Removal Action (Mason & Hanger–Silas Mason 1990)	1990	Six sumps were removed from Line 9 near Buildings 9-14, 9-57, and 9-58.	The sumps were identified as Priority 3 sumps: not currently in use and with no known future production schedules or M-Day schedules. It was recommended that these sumps remain permanently closed.
Facility-wide Preliminary Assessment (JAYCOR 1994a)	1991	A preliminary assessment was conducted for Line 9 to evaluate the potential for contamination and assess potential migration pathways and exposure potential if contamination were present.	The principal explosives used at this facility were Composition B and PBX. It was recommended that a walk-over and field survey of Line 9 be conducted to identify signs of past release of contaminants and locate possible buried items. If the field reconnaissance survey indicated possible past release of contaminants, then it was recommended that several monitoring wells be installed and sampled around the perimeter of Line 9 to detect possible contaminant migration.
Facility-wide Site Inspection (JAYCOR 1992)	1991	Eight soil samples and two surface water samples were collected from excavated sump pits (associated with the 1990 sump removals) and stormwater drainages at Line 9 and analyzed for explosives, metals, and VOCs.	Four soil samples from excavated sump pits, one soil sample from a storm drainage, and one soil sample from an old gravel filter bed contained metals above the SI evaluation criteria. Two surface water samples from standing water at the bottom of excavated sump pits contained metals and explosives above the SI evaluation criteria. Based on the SI analytical results, it was recommended that Line 9 be further investigated during the Phase I RI.

Table 5.8-1. Previous Investigations and Remedial Actions—Line 9

Iowa Army Ammunition Plant, Middletown, Iowa

Facility-wide Phase I Remedial Investigation (JAYCOR 1993a)	1992	Phase I RI sampling included soil, soil gas, groundwater, surface water, and sediment sampling: • Four areas around previously excavated sumps were screened for metals and explosives. • Nine at-depth soil samples were obtained downgradient of the excavated sumps during the installation of piezometers and analyzed for metals and explosives. • A soil gas survey was performed at Buildings 9-57 and 9-59. • Three piezometers were installed and sampled for explosives. One piezometer was additionally sampled for metals. • One onsite sediment sample and one onsite surface water sample were collected from a ditch downgradient of Building 9-59. In addition, two basewide sediment samples and two basewide surface water samples were collected approximately 750 feet north (upgradient) and 250 feet south (downgradient) of the site in an intermittent stream. All sediment/surface water samples were analyzed for metals and explosives.	None of the screening or at-depth soil samples collected were reported to contain explosives. Metals screening results indicated isolated areas of metals contamination, specifically lead and copper, localized around the removed sumps and in drainage pathways up to depths of 1 foot. The report concluded that no further sampling of soils for metals or explosives contamination was necessary. The soil gas survey detected VOC contamination to the east of Building 9-57. No explosives were reported in the groundwater samples. Metals were detected above the RI evaluation criteria in R10-PZ-03, on the southeast side of Building 9-58. In sediment, metals were detected above the RI evaluation criteria from samples upgradient of Line 9 (arsenic, chromium, and lead), downgradient of Line 9 (lead), and from a ditch downgradient of Building 9-59 (chromium and copper). No metals or explosives contamination was reported in the surface water samples. The report recommended further groundwater investigation to assess the VOCs found during the gas survey and to determine if groundwater had been impacted due to metals contamination associated with the excavated sumps.

Table 5.8-1. Previous Investigations and Remedial Actions—Line 9

Iowa Army Ammunition Plant, Middletown, Iowa

Follow-On Remedial Investigation (JAYCOR 1996)	1993–1995	In 1993, three monitoring wells (JAW-29, JAW-30, and JAW-31) were installed at Line 9 as part of the Phase II RI. Soil and groundwater samples were collected during installation and analyzed for VOCs, SVOCs, and metals. Soil samples were collected from 15.5 to 16.5 feet bgs. In 1995, three additional shallow monitoring wells (JAW-610, JAW-611, and JAW-612) were installed as part of the follow-on sampling. Three soil samples were collected from 8.0 to 5.0 feet bgs at three locations. One soil sample was collected north (upgradient) of the Building 9-57 sump, and the other two soil samples were collected south and east (downgradient) of the sump. Soil and groundwater samples were analyzed for VOCs, SVOCs, metals, and explosives. Groundwater samples were also collected from the existing three wells onsite.	Soil results for metals agreed with prior conclusions that metals contamination existed in isolated areas localized around the removed sumps and in drainage pathways up to depths of 1 foot bgs. No explosives were detected in soil. Two soil samples reported detectable levels of SVOCs. One VOC, chlorobenzene, was detected in the sample collected during the installation of well JAW-611. In groundwater, metals were detected in all six wells. The report concluded that based on the concentrations of metals observed in groundwater and in surface water/sediment samples at local shallow groundwater discharge zones, the extent of metals was localized in the surficial soils and shallow groundwater surrounding the sump at Building 9-57. One SVOC, phenanthrene, was detected in one groundwater sample (JAW-30) during the 1995 follow-on sampling. VOCs were reported in wells JAW-29, JAW-30, and JAW-31 during Phase II RI sampling in 1993, and only in JAW-31 during follow-on sampling in 1995. No explosives were detected in any of the six Line 9 monitoring wells. The report concluded that since soil samples did not detect contamination, and the soil gas survey suggested that VOC contamination exists, the area will be evaluated under the groundwater FS.
Sump Removal Action (OHM 1996)	1995	Five 5-foot-diameter steel sumps were removed from Line 9. Approximately 69.5 cubic yards of soil and material was removed.	Confirmation samples were taken and analyzed for metals and explosives prior to backfilling.
Periodic Groundwater Monitoring (multiple reports)	1996–2010	Periodic groundwater sampling was conducted at Line 9. Monitoring wells JAW-29, JAW-30, JAW-31, JAW-601, JAW-611, and/or JAW-612 were analyzed for VOCs, explosives, and natural attenuation parameters. Well L9-MW11 was also sampled periodically after its installation in 2003.	PCP regularly exceeded the MCL (1 µg/L) in shallow well JAW-31, located east of Building 9-57. PCP has not been detected in soil, nor has it been detected in intermediate or deep groundwater. 1,1-DCE was detected above the screening level once each at two wells (JAW-612 and L9-MW11), and Freon 113 was regularly detected above screening levels in six wells (JAW-29, JAW-30, JAW-31, JAW-611, JAW-612, and L9-MW11). During the last events in 2008 and 2010, PCP was detected at concentrations of 3.3 µg/L and 5.6 µg/L, respectively. During the 2008 event, the maximum concentration of Freon 113 was detected at a concentration of 280,000 µg/L. Freon 113 was not analyzed in 2010.

Table 5.8-1. Previous Investigations and Remedial Actions—Line 9

Iowa Army Ammunition Plant, Middletown, Iowa

Supplemental Groundwater Remedial Investigation Report (MWH 2001)	1997	Nine groundwater and 50 soil samples were collected from 14 soil borings in the vicinity of Building 9-57 and analyzed for VOCs.	Freon 113 was detected in all groundwater and soil samples, ranging from 1,500 µg/L to 270,000 µg/L in groundwater and from 0.017 mg/kg to 9,000 mg/kg in soil. The highest concentrations were located east of Building 9-57. Vertically, the extent of Freon contamination was determined to be between 23 and 33 feet bgs. A low concentration of 1,1,1-trichloroethane was detected in one soil sample at a depth of 5 feet bgs. Methylene chloride and toluene were detected in some samples but also in the blank and were considered laboratory contaminants.
Record of Decision for Soils OU-1 (Harza 1998)	1998	The final ROD for OU-1 was issued to address contaminated soils at IAAAP. The ROD presented the selected remedial action for OU-1.	The selected remedy included excavation for soil contaminated with metals and explosives at Line 9.

Table 5.8-1. Previous Investigations and Remedial Actions—Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Line 9 Groundwater Feasibility Study Data Collection and Remedial Alternatives Analysis (URS 2004c)	2002–2003	To support the development of a Feasibility Study for Line 9, a field survey, geologic soil logging and geotechnical sampling, DPT groundwater sampling, monitoring well installation and sampling, aquifer slug testing, and surface water sampling were conducted. Forty DPT borings were advanced. Seventy-nine groundwater samples were collected from 39 borings of the 40 DPT borings and analyzed for VOCs. Thirteen new overburden monitoring wells were installed and sampled for explosives, VOCs, SVOCs, and natural attenuation parameters. The report also considered the periodic groundwater monitoring data from six existing wells. Groundwater flow and contaminant fate and transport in the saturated zone at Line 9 was modeled using the MODFLOW and MT3DMS numerical computer modeling programs, respectively. A risk assessment was completed to assess potential risk to human health associated with current or future exposures to groundwater at Line 9.	The primary contaminants detected in groundwater included Freon 113 and PCP with maximum concentrations of 190,000 µg/L and 8 µg/L, respectively. However, PCP groundwater exceedances were only observed in one well, JAW-31. RDX was also detected in groundwater; however, the maximum concentration of 0.89 µg/L was below the HAL of 2 µg/L. Freon 113 was the most extensive contaminant at Line 9 with generally higher concentrations near the two previously excavated sumps and near the Line 9 drainage ditches. It was concluded that residual free product (Freon 113) could be present given that groundwater concentrations were similar to the chemical's solubility limit. The Freon 113 plume was confined primarily to the Line 9 area, and concentrations decreased with depth. Nondetect groundwater samples collected south of Line 9 and adjacent to the tributary of Brush Creek indicate there is no impact to surface water or groundwater south of L9-MW7 The groundwater fate and transport model predicted that Freon 113 concentrations in groundwater would continue to decline over time due to the naturally occurring processes of dispersion and biodegradation. The Freon 113 plume could continue to migrate another 100 feet. The initial natural attenuation evaluation indicated that conditions could be favorable for degradation of Freon 113, and concentrations appeared to be slowly decreasing over time. However, the presence of potential free product could be a limiting factor. Freon 113 and PCP were identified as final COCs for groundwater. Following the risk assessment, four remedial alternatives were evaluated to prevent construction worker exposure and commercial/industrial worker ingestion of COCs in groundwater for inclusion in the FS report.
Phase 4 Remedial Design Investigation (TN & Associates 2003b; Shaw 2004b)	2003	Surface and subsurface soil samples were collected from 57 locations at Line 9 where historical documentation and/or previous environmental sampling indicated a potential for contamination, including former Buildings 9-14, 9-57, 9-58, 9-59, 9-59-1, 9-60, 9-61, and 9-64, and storage magazines. Depending on the sample location, soil samples were analyzed for explosives, VOCs, SVOCs, PCBs, and/or metals.	No SVOCs or PCBs were detected in soil samples. VOCs were detected at low levels; however, there were no VOCs (including Freon 113) that exceeded OU-1 RGs or applicable screening levels. RDX was the only explosive, and mercury the only metal, detected above OU-1 RGs. RDX exceeded the OU-1 RG at the former Building 9-57 area. Mercury exceeded the OU-1 RG in the former Building 9-61 area.

Table 5.8-1. Previous Investigations and Remedial Actions—Line 9
Iowa Army Ammunition Plant, Middletown, Iowa

Remedial Action Report for Phase 4 Soil Sites, OU-1 (Shaw 2005b)	2004	Eighty-four cubic yards of RDX-contaminated soil was removed to approximately 6 feet bgs adjacent to Building 9-57, and 36 cubic yards of mercury-contaminated soil was removed to approximately 2.5 feet bgs adjacent to Building 9-61.	Contaminated soils were transported to the IDA for treatment and/or disposal. Post-excavation verification samples were collected, and they confirmed that all contaminated soil had been removed. It was determined that no further excavation was required for either area. The excavations were backfilled with clean soil.
Groundwater Treatability Study (Tetra Tech 2008a)	2005–2006	A groundwater treatability study was conducted at the south end of Line 9 in 2005–2006 to test the efficacy of enhanced in situ bioremediation at reducing the highest concentrations of Freon 113 to levels that could be further remediated using natural attenuation. A test area approximately 50 feet by 50 feet was established, and boreholes were installed for the injection of a dextrose/fructose solution, high-fructose corn syrup (HFCS). Four new small-diameter monitoring wells were installed to supplement the existing monitoring wells. Two injections were conducted. Seven monitoring wells were sampled as part of the study: two in the source area, four upgradient, and one downgradient. Samples were analyzed for Freon 113, geochemical parameters, alkalinity, carbon dioxide, and total organic carbon.	It was concluded that the addition of a carbon amendment enhanced the natural degradation process of Freon 113, with the dominant degradation pathway to chloride. Because Freon 113 concentrations within the study area decreased below the screening level, no further treatability testing was conducted here.
Comprehensive Watersheds Evaluation and Supplemental Data Collection Work Plan (Tetra Tech 2006b)	2005	A comprehensive evaluation of all IAAAP sites and the four primary watersheds (Brush Creek, Spring Creek, Long Creek, and Skunk River) was conducted to identify data gaps and additional data needed to complete a feasibility study for surface water and groundwater at each of the IAAAP sites.	The work plan concluded that groundwater, soil, surface water, and sediment had been adequately characterized and proposed no additional investigation.
Explanation of Significant Differences for the Records of Decision for Soils, OU-1 (Leidos 2018)	2018	The addition of LUCs to the selected remedy for the soils ROD was documented to provide overall protectiveness of human health and the environment.	The Explanation of Significant Differences changes will apply to soil at Line 9.
OU-1 Land Use Controls Implementation Plan (Leidos 2019)	2019	The process for implementation and maintenance of LUCs as a component of the selected remedy for OU-1 was outlined. Institutional controls will be used to restrict land use at OU-1 areas to military, commercial/industrial, agricultural, and permitted hunting and prohibit residential use. Engineering controls (fencing, signs) will be used to prevent general access to areas.	The scope of the LUCIP applies to Line 9.

Table 5.8-3. Gauging Information—Line 9

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Gauging Date	Screen Interval (ft btoc)	Depth to Water (ft btoc)	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)
JAW-29	4/20/2018	9-19	6.64	713.93	707.29
JAW-30	4/20/2018	9-19	7.32	714.15	706.83
JAW-31	4/20/2018	9-19	6.52	713.47	706.95
L9-MW1	4/20/2018	55-65	11.79	712.24	700.45
L9-MW2	4/20/2018	93.8-98.8	11.82	712.28	700.46
L9-TT-MW02	4/20/2018	5-25	4.92	NM	NA

Notes:

ft = feet

btoc = below top of casing

amsl = above mean sea level

NA = Not Available

NM = Not Measured

Table 5.8-4. Detected Chemicals in Groundwater—Line 9
Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-29								JAW-30				
					Sample ID	JAW-29-20001025	JAW-29-20010530	JAW-29-20020628	JAW-29-20030520	F04-GW-059	S07-JAW-29-GW-REG	S08-JAW-29-GW-REG	JAW29-0418	JAW-30-20001024	JAW-30-20010529	JAW-30-20020627	JAW-30-20030519	F04-GW-061
					Sample Depth (ft)	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19
					Sample Date	10/25/2000	5/30/2001	6/28/2002	5/20/2003	11/17/2004	6/6/2007	5/6/2008	4/22/2018	10/24/2000	5/29/2001	6/27/2002	5/19/2003	11/17/2004
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])													
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	250000	160000	190000	250000	250000	- -	- -	- -	270000	260000	280000	270000	270000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	10 U	10 U	60	- -	- -	- -	- -	20	10 U	10 U	20 U	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	76000	22000	84000	14000	5300	- -	- -	- -	73000	36000	120000	40000	4600
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1200	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	1800	1000 U	1000 U	1000 U	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	1200 U	300 U	300 U	300 U	- -	- -	- -	- -	300 U	300 U	300 U	300	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1200	1000 U	1000 U	1000 U	1000	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	5000	4000	5000	6000	5000	- -	- -	- -	4600	4000	4000	4000	3000
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	200	- -	- -	- -	- -	- -	- -	- -	400
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	1100	90	110	340	- -	- -	- -	- -	100	50	50	50 U	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	100 U	- -	- -	- -	- -	- -	- -	- -	100 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	56000	54000	53000	52000	48000	- -	- -	- -	59000	59000	68000	72000	65000
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00072 U	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00047 U	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00048 J	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.0007 J	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00058 J	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.0018 U	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00072 U	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.2 U	1.2 U	0.56 U	0.29 U	0.5 U	- -	- -	- -	0.77 U	1.2 U	0.7 U	0.2 U	0.48 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	0.5 U	- -	- -	- -	- -	- -	- -	- -	0.48 U
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.2 U	0.92 U	0.56 U	0.29 U	0.5 U	- -	- -	- -	0.77 U	0.95 U	0.7 U	0.2 U	0.48 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.1 U	0.92 U	0.56 U	0.29 U	0.5 U	- -	- -	- -	0.72 U	0.95 U	0.7 U	0.2 U	0.48 U
METALS	7440-70-2	Calcium	µg/L	--	119033	71000	50100	- -	- -	- -	- -	- -	- -	70100	65900	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	26800	20500	- -	- -	- -	- -	- -	- -	29600	32300	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	15200	11300	- -	- -	- -	- -	- -	- -	17900	16900	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	9 U	R	10 U	- -	- -	- -	- -	- -	10 U	R	9 U
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	5 U	5 U	5 U	R	5 U	- -	- -	- -	5 U	5 U	5 U	5 U	5 U
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	5 U	5 U	5 U	5 U	5 U	- -	- -	- -	5 U	5 U	5 U	5 U	5 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	9 U	R	10 U	- -	- -	- -	- -	- -	10 U	R	9 U
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	*75*	5 U	5 U	5 U	5 U	- -	- -	- -	*150*	5 U	5 U	5 U	5 U
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	5 U	5 U	5 U	R	5 U	- -	- -	- -	5 U	5 U	5 U	R	5 U
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	5 U	5 U	5 U	R	5 U	- -	- -	0.4	5 U	5 U	5 U	5 U	5 U
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	5 U	5 U	5 U	5 U	5 U	- -	- -	- -	5 U	5 U	5 U	5 U	5 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	150 U	300 U	1500 U	150 U	60 U	5000 U	- -	- -	60 U	3 U	1500 U	300 U	150 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	*150000*	*72000*	*83000*	*71000*	*190000 D*	*808000 E*	*169000*	- -	*64000*	140000 B	*64000*	*87000*	*80000 D*
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	150 U	300 U	1500 U	150 U	60 U	5000 U	- -	- -	60 U	3 U	1500 U	300 U	150 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	150 U	15000 U	1500 U	150 U	60 U	5000 U	- -	- -	60 U	15000 U	1500 U	300 U	150 U
VOLATILES	67-64-1	Acetone	µg/L	18000	--	500 U	1000 U	10000 U	500 U	200 U	130000 U	- -	- -	200 U	10 U	5000 U	1000 U	500 U
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	150 U	300 U	1500 U	150 U	60 U	10000 U	- -	- -	60 U	3 U	1500 U	300 U	150 U
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	150 U	300 U	1500 U	150 U	60 U	10000 U	- -	- -	60 U	3 U	1500 U	300 U	150 U
VOLATILES	67-66-3	Chloroform	µg/L	80	--	150 U	300 U	1500 U	150 U	60 U	5000 U	- -	- -	60 U	3 U	1500 U	300 U	150 U
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	0.53 J	- -	- -	- -	- -	- -	- -	- -	0.62 J
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	500 U	1000 U	5000 U	500 U	200 U	25000 U	- -	- -	200 U	10 U	5000 U	1000 U	500 U
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	150 U	*6500*	1500 U	150 U	60 U	*7060 JB*	- -	- -	60 U	3 U	1500 U	300 U	150 U
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	150 U	300 U	1500 U	150 U	60 U	15000 U	- -	- -	60 U	3 U	1500 U	300 U	150 U

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-30			JAW-31									
					Sample ID	S07-JAW-30-GW-REG	S08-JAW-30-GW-REG	JAW30-0418	JAW-31-20001025	JAW-31-20010530	JAW-31-20020627	JAW-31-20030519	F04-GW-062	S07-JAW-31-GW-REG	S08-JAW-31-GW-REG	JAW-31-082010	JAW31-0418	LINE9-FD1
					Sample Depth (ft)	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19	9 - 19
					Sample Date	6/7/2007	5/6/2008	4/20/2018	10/25/2000	5/30/2001	6/27/2002	5/19/2003	11/17/2004	6/6/2007	5/7/2008	8/20/2010	4/20/2018	4/20/2018
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])													
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	250000	230000	260000	280000	280000	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	10	10 U	10 U	20 U	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	77000	36000	110000	65000	4300	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	1200 U	300 U	300 U	600	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	17000	13000	10000	5400	21000	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	10000	9000	11000	9000	10000	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	200 U	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	10 U	10 U	10 U	50	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	100 U	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	50000	65000	65000	58000	51000	- -	- -	- -	- -	- -
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00075 J	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00022 U	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00024 U	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00021 U	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00027 U	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.0012 J	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00075 J	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	0.78 U	0.52 U	0.62 U	0.31 U	0.5 P	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.48 U	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	- -	0.78 U	0.42 U	0.62 U	0.31 U	0.48 U	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	- -	- -	0.73 U	0.42 U	0.62 U	0.28 J	0.48 U	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	64900	61200	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	26700	29500	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	16700	20200	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	- -	- -	- -	10 U	R	10 U	24 U	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	- -	- -	- -	5 U	5 U	5 U	5 U	5 U	9.5 U	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	- -	- -	- -	1 J	5 U	4 J	4 J	3 J	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	23	R	14	24 U	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	*56*	5 U	5 U	5 U	5 U	4.8 U	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	5 U	5 U	5 U	R	5 U	4.8 U	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	- -	- -	0.0058 UJ	5 U	5 U	1 J	*8*	*12*	24 U	*3.3*	*5.6*	0.0057 UJ	0.0061 UJ
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	- -	- -	- -	1 J	5 U	2 J	2 J	2 J	4.8 U	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	1000 U	- -	- -	300 U	300 U	6000 U	600 U	300 U	1000 U	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	*77200*	*136000*	- -	*100000*	220000 B	*230000*	*190000*	*170000 D*	*39900*	*154000 J*	- -	- -	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	1000 U	- -	- -	300 U	300 U	6000 U	600 U	300 U	1000 U	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	1000 U	- -	- -	300 U	15000 U	6000 U	600 U	300 U	1000 U	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	25000 U	- -	- -	1000 U	1000 U	40000 U	2000 U	1000 U	25000 U	- -	- -	- -	- -
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	2000 U	- -	- -	300 U	300 U	6000 U	600 U	300 U	2000 U	- -	- -	- -	- -
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	2000 U	- -	- -	300 U	300 U	6000 U	600 U	300 U	2000 U	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	1000 U	- -	- -	300 U	300 U	6000 U	600 U	300 U	1000 U	- -	- -	- -	- -
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	24	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	5000 U	- -	- -	1000 U	1000 U	20000 U	2000 U	1000 U	5000 U	- -	- -	- -	- -
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	*1450 JB*	- -	- -	300 U	300 U	6000 U	600 U	300 U	*1360 J*	- -	- -	- -	- -
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	3000 U	- -	- -	300 U	300 U	6000 U	600 U	300 U	3000 U	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-610				JAW-611				JAW-612		
					Sample ID	JAW-610-20001023	JAW-610-20010530	JAW-610-20020626	JAW-610-20030518	JAW-611-20001023	JAW-611-20010530	JAW-611-20020626	JAW-611-20030519	JAW-612-20001024	JAW-612-20001024-FD	JAW-612-20010530
					Sample Depth (ft)	8 - 18	8 - 18	8 - 18	8 - 18	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5
					Sample Date	10/23/2000	5/30/2001	6/26/2002	5/18/2003	10/23/2000	5/30/2001	6/26/2002	5/19/2003	10/24/2000	10/24/2000	5/30/2001
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])											
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	270000	240000	250000	220000	270000	250000	270000	280000	240000	240000	210000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	20	80	10 U	20 U	10 U	60	20	20 U	10 U	10 U	10 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	70000	38000	110000	36000	140000	62000	120000	100000	180000	170000	70000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	2600	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	300 U	400	300 U	300 U	300 U	300 U	300 U	300 U	300 U
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000 U	1000	1000 U	1000 U	1000 U	1000	1000 U	1300	1000	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	6200	7000	7000	4000	15000	18000	12000	8000	5500	5100	6000
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	4300	5100	4000	2400	1200	1200	1600	2200	1100	1200	1100
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	41000	36000	41000	50000	55000	56000	53000	53000	41000	39000	30000
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.5 U	1.5 U	0.87 U	0.86 U	0.95 U	0.71 U	0.56 U	1.2 U	0.69 U	0.69 U	0.71 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.5 U	1.2 U	0.87 U	0.86 U	0.95 U	0.57 U	0.56 U	1.2 U	0.69 U	0.69 U	0.57 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.4 U	1.2 U	0.87 U	0.86 U	0.56	0.82	1.1	0.89 J	0.65 U	0.65 U	0.57 U
METALS	7440-70-2	Calcium	µg/L	--	119033	70500	68800	- -	- -	70500	69200	- -	- -	64800	63000	55500
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	25400	28800	- -	- -	32000	33300	- -	- -	25900	25300	26800
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	15400	15100	- -	- -	13200	13700	- -	- -	11000	10700	10700
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	10 U	R	- -	- -	10 U	10 U	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	10 U	R	- -	- -	10 U	10 U	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	*40*	5 U	2 J	5 U	*180*	5 U	5 U	5 U	*31 J*	*10*	5 U
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	5 U	5 U	5 U	R	5 U	5 U	5 U	R	5 U	5 U	5 U
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	3 U	30 U	3 U	30 U	300 U	600 U	60 U	30 U	30 U	300 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	730	870	1000	390	*31000*	31000 B	*24000*	*25000*	10000	10000	8100
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	3 U	30 U	3 U	30 U	300 U	600 U	60 U	30 U	30 U	300 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	3 U	30 U	3 U	30 U	300 U	600 U	60 U	30 U	30 U	300 U
VOLATILES	67-64-1	Acetone	µg/L	18000	--	10 U	10 U	100 U	10 U	100 U	1000 U	2000 U	200 U	100 U	100 U	1000 U
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	3 U	3 U	30 U	3 U	30 U	300 U	600 U	60 U	30 U	30 U	300 U
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	3 U	3 U	30 U	3 U	30 U	300 U	600 U	60 U	30 U	30 U	300 U
VOLATILES	67-66-3	Chloroform	µg/L	80	--	3 U	3 U	30 U	3 U	30 U	300 U	600 U	60 U	30 U	30 U	300 U
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	10 U	10 U	100 U	10 U	100 U	1000 U	2000 U	200 U	100 U	100 U	1000 U
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	3 U	3 U	30 U	3 U	30 U	300 U	600 U	60 U	30 U	30 U	300 U
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	3 U	3 U	30 U	3 U	30 U	300 U	600 U	60 U	30 U	30 U	300 U

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	JAW-612					L9-DP01			L9-DP02			L9-DP03		
					Sample ID	JAW-612-20010530-FD	JAW-612-20020627	JAW-612-20020627-FD	JAW-612-20030518	JAW-612-20030518-FD	L9-DP01-63	L9-DP01-71	L9-DP01-20	L9-DP02-22	L9-DP02-60	L9-DP02-70	L9-DP03-70	L9-DP03-22	L9-DP03-53
					Sample Depth (ft)	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	6.5 - 16.5	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	5/30/2001	6/27/2002	6/27/2002	5/18/2003	5/18/2003	11/10/2002	11/10/2002	11/12/2002	11/9/2002	11/9/2002	11/20/2002	11/6/2002	11/7/2002	11/7/2002
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])														
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	220000	230000	230000	230000	240000	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	10 U	10 U	50 J	20 U	20 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	60000	101200	101200	120000	130000	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	300 U	300 U	300 U	300 U	300 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	6000	13000	13000	10000	10000	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	1100	1200	1100	1000	1000	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	30000	35000	33000	38000	36000 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	0.7 U	1 U	0.81 U	0.13 U	0.52 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	0.56 U	1 U	0.81 U	0.1 J	0.52 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	0.56 U	1 U	0.81 U	0.13 U	0.52 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	56600	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	26500	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	10600	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	10 U	10 U	R	R	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	5 U	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	5 U	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	10 U	10 U	R	R	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	5 U	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	5 U	5 U	5 U	R	R	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	5 U	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	5 U	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	1500 U	150 U	300 U	15 U	3 U	- -	3 U	3 U	- -	3 U	3 U	3 UJ	- -	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	*12000*	*17000*	- -	9000	*11000*	- -	- -	*37000 D*	2400 D	- -	5 U	14 J	440 D	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	1500 U	150 U	300 U	15 U	3 U	- -	3 U	3 U	- -	3 U	3 U	3 UJ	- -	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	1500 U	*51 J*	300 U	15 U	3 U	- -	3 U	3 U	- -	3 U	3 U	3 UJ	- -	3 U
VOLATILES	67-64-1	Acetone	µg/L	18000	--	5000 U	1000 U	2000 U	50 U	10 U	- -	10 U	10 U	- -	10 U	10 U	10 UJ	- -	10 U
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	1500 U	150 U	300 U	15 U	3 U	- -	3 U	3 U	- -	3 U	3 U	3 UJ	- -	3 U
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	1500 U	150 U	300 U	15 U	3 U	1 J	- -	3 U	- -	3 U	3 U	3 UJ	- -	3 U
VOLATILES	67-66-3	Chloroform	µg/L	80	--	1500 U	150 U	300 U	15 U	3 U	- -	3 U	3 U	- -	3 U	3 U	3 UJ	- -	3 U
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	5000 U	500 U	1000 U	50 U	10 U	5 J	- -	3 U	- -	10 U	10 U	10 UJ	- -	10 U
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	1500 U	150 U	300 U	15 U	3 U	- -	3 U	3 U	- -	3 U	3 U	3 UJ	- -	3 U
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	1500 U	150 U	300 U	15 U	3 U	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	L9-DP04		L9-DP04		L9-DP05			L9-DP06			L9-DP07		L9-DP08		L9-DP09		L9-DP10	
					Sample ID	L9-DP04-53	L9-DP04-69	L9-DP04-24	L9-DP05-73	L9-DP05-53	L9-DP05-25	L9-DP06-52	L9-DP06-67	L9-DP06-25	L9-DP07-62	L9-DP07-75	L9-DP07-26	L9-DP08-25	L9-DP08-55	L9-DP09-66	L9-DP10-25	L9-DP10-55	L9-DP10-65
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	11/5/2002	11/5/2002	11/7/2002	10/30/2002	11/5/2002	11/7/2002	11/6/2002	11/6/2002	11/7/2002	10/30/2002	11/4/2002	11/7/2002	11/10/2002	11/10/2002	11/10/2002	11/5/2002	11/5/2002	11/5/2002
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])																		
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	150	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	1500 JD	- -	*70000 D*	330 D	*37000 D*	*47000 D*	*30000 JD*	- -	*92000 D*	1200 D	1100 D	*20000 JD*	3100 D	- -	7	- -	*60000 D*	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	*8*	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	- -	- -	3 U
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	10 U	10 U	10 U	10 U	10 U	- -	10 U	10 U	10 U	10 U	10 U	- -	10 U	10 U	- -	- -	10 U
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	- -	- -	3 U
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	- -	- -	3 U
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	- -	- -	3 U
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	- -	10 U	10 U	10 U	10 U	10 U	- -	10 U	10 U	10 U	10 U	10 U	- -	10 U	10 U	- -	- -	10 U
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	3 U	3 U	3 U	- -	3 U	3 U	- -	- -	3 U
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])	L9-DP11		L9-DP12		L9-DP12	L9-DP13		L9-DP14			L9-DP15		L9-DP16	L9-DP17	L9-DP19		L9-DP20	
					Sample ID	L9-DP11-69	L9-DP11-23	L9-DP12-54	L9-DP12-25	L9-DP12-64	L9-DP13-20	L9-DP13-64	L9-DP14-53	L9-DP14-66	L9-DP14-25	L9-DP15-60	L9-DP15-25	L9-DP16-62	L9-DP17-62	L9-DP19-25	L9-DP19-54	L9-DP20-39	L9-DP20-20
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	11/7/2002	11/8/2002	11/9/2002	11/10/2002	11/19/2002	11/8/2002	11/8/2002	11/7/2002	11/7/2002	11/18/2002	11/8/2002	11/9/2002	11/8/2002	11/12/2002	11/10/2002	11/12/2002	11/11/2002	11/12/2002
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 UJ	3 U	3 U	3 U	3 U	- -	3 UJ	3 U	- -	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	5 UJ	1100 D	5 U	53	5 U	7800 D	- -	- -	18 J	*120000 D*	5 U	8	5 U	5 U	5 U	5 U	1 J	5 U
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 UJ	3 U	3 U	3 U	3 U	- -	3 UJ	3 U	- -	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 UJ	3 U	3 U	3 U	3 U	- -	3 UJ	3 U	- -	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	67-64-1	Acetone	µg/L	18000	--	10 UJ	10 U	10 U	10 U	10 U	- -	10 UJ	10 U	- -	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	3 UJ	3 U	3 U	3 U	3 U	- -	3 UJ	3 U	- -	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	3 UJ	3 U	3 U	3 U	3 U	- -	3 UJ	3 U	- -	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	67-66-3	Chloroform	µg/L	80	--	3 UJ	3 U	3 U	3 U	3 U	- -	3 UJ	3 U	- -	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	10 UJ	10 U	10 U	10 U	10 U	- -	10 UJ	10 U	- -	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	3 UJ	3 U	3 U	3 U	3 U	- -	3 UJ	3 U	- -	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	L9-DP21		L9-DP22		L9-DP23		L9-DP24	L9-DP25	L9-DP26		L9-DP27	L9-DP28	L9-DP29	L9-DP30	L9-DP31	L9-DP32	L9-DP33		L9-DP34
					Sample ID	L9-DP21-62	L9-DP21-20	L9-DP22-54	L9-DP22-20	L9-DP23-59	L9-DP23-44	L9-DP24-21	L9-DP25-24	L9-DP26-50	L9-DP26-19	L9-DP27-20	L9-DP28-20	L9-DP29-20	L9-DP30-10	L9-DP31-22	L9-DP32-15	L9-DP33-47	L9-DP33-22	L9-DP34-60
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0
					Sample Date	11/11/2002	11/12/2002	11/11/2002	11/18/2002	11/19/2002	11/20/2002	11/20/2002	11/20/2002	11/20/2002	11/21/2002	11/20/2002	11/20/2002	11/21/2002	11/21/2002	11/22/2002	11/21/2002	11/24/2002	11/26/2002	11/25/2002
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])																			
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	5 U	5 U	5 U	35	180	5 U	5 U	5 U	5 U	710 D	10	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	67-64-1	Acetone	µg/L	18000	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	4
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	67-66-3	Chloroform	µg/L	80	--	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	8 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	L9-DP35		L9-DP36		L9-DP37	L9-DP38	L9-DP39	L9-DP40	L9-MW1		L9-MW10	L9-MW11				
					Sample ID	L9-DP35-46	L9-DP35-20	L9-DP36-21	L9-DP36-45	L9-DP37-07	L9-DP38-07	L9-DP39-07	L9-DP40-05	L9-MW1-20030511	L9MW1-0418	L9-MW10-20030509	L9-MW11-20030511	F04-GW-058	L9-MW11	L9-MW11-140605	L9-MW11-01R2
					Sample Depth (ft)	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	0 - 0	55 - 65	55 - 65	51.4 - 61.4	14.5 - 29.5	14.5 - 29.5	14.5 - 29.5	14.5 - 29.5	14.5 - 29.5
					Sample Date	11/25/2002	12/2/2002	11/26/2002	11/26/2002	11/25/2002	11/25/2002	11/26/2002	12/3/2002	5/11/2003	4/21/2018	5/9/2003	5/11/2003	11/16/2004	5/18/2005	6/14/2005	7/12/2005
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])																
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	410000	- -	470000	280000	200000	260000	280000	260000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	200	- -	580	30	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	78000	- -	95000	- -	5000	1400000	120000	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1000 U	- -	1000 U	1000 U	1000 U	- -	- -	40
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1000 U	- -	1000 U	1000 U	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	300 U	- -	1500	300 U	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	1000 U	- -	1000 U	1000 U	1000 U	1000 U	1800	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	2000	- -	2000	4000	4000	2000	2000	3000
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	300	300
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1700	500	400	500
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	100	- -	50 U	2400	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	100 U	100 U	100 U	100 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	14000	- -	23000	22000	27000	22000	19000	26000
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00046 U	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.0004 U	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00045 U	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00037 U	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00046 U	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00038 U	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.00046 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	0.55 U	- -	1.3 U	0.69 U	0.48 U	0.49 U	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.59	0.49 U	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	0.55 U	- -	1.3 U	0.69 U	0.48 U	0.49 U	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	0.55 U	- -	1.3 U	0.69 U	0.22 JP	0.49 U	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	86200	- -	91700	62400	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	920	175	32.1 B
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	33300	- -	34300	26600	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	*1330*	345	270
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	19500	- -	29600	15000	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	- -	- -	- -	- -	- -	- -	10 U	- -	10 U	10 U	9 U	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -	5 U	5 U	5 U	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -	5 U	5 U	5 U	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	10 U	- -	10 U	10 U	9 U	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -	5 U	5 U	5 U	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	- -	- -	- -	R	- -	R	R	5 U	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	- -	- -	- -	- -	- -	- -	- -	- -	5 U	0.27	5 U	5 U	5 U	- -	- -	- -
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	- -	- -	- -	- -	- -	- -	- -	- -	5 U	- -	5 U	5 U	5 U	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	3 U	- -	3 U	3 U	3 U	30 U	3 U	300 U	- -	3 U	2	2.5 J	10 U	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	5 U	30	*14000 D*	- -	5 U	*14000 D*	*14000 D*	1200 D	8100	- -	3 U	*68000*	*180000 D*	*190000 D*	*110000*	*81000*
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	3 U	- -	3 U	3 U	3 U	30 U	3 U	300 U	- -	3 U	3 U	3 U	10 U	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	3 U	- -	3 U	3 U	3 U	30 U	3 U	300 U	- -	3 U	3 U	3 U	10 U	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	10 U	10 U	- -	10 U	10 U	10 U	100 U	10 U	1000 U	- -	10 U	10 U	2800 D	50 U	- -	- -
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	3 U	3 U	- -	3 U	3 U	3 U	30 U	3 U	300 U	- -	3 U	3 U	3 U	10 U	- -	- -
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	3 U	3 U	- -	3 U	3 U	3 U	30 U	3 U	300 U	- -	3 U	3 U	3 U	10 U	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	3 U	3 U	- -	3 U	3 U	3 U	30 U	3 U	300 U	- -	3 U	3 U	3 U	10 U	- -	- -
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.7 U	1.7 U	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.8 U	1.8 U	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.1	2.2	0.47 J	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	10 U	10 U	- -	10 U	10 U	10 U	100 U	10 U	1000 U	- -	10 U	10 U	10 U	50 U	- -	- -
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	3 U	3 U	- -	3 U	3 U	3 U	30 U	3 U	300 U	- -	3 U	3 U	3 U	20 U	- -	- -
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	300 U	- -	3 U	3 U	3 U	15 U	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	L9-MW11				L9-MW11		L9-MW12							
					Sample ID	L9-MW11-01R3	L9-MW11-01R4	L9-MW11-02R1	L9-MW11-02R2	S07-L9-MW11-GW-REG	S08-L9-MW11-GW-REG	L9-MW12-20030510	L9-MW12	L9-MW12-140605	L9-MW12-01R2	L9-MW12-01R3	L9-MW12-01R4	L9-MW12-02R1	L9-MW12-02R2
					Sample Depth (ft)	14.5 - 29.5	14.5 - 29.5	14.5 - 29.5	14.5 - 29.5	14.5 - 29.5	14.5 - 29.5	49.6 - 59.6	49.6 - 59.6	49.6 - 59.6	49.6 - 59.6	49.6 - 59.6	49.6 - 59.6	49.6 - 59.6	49.6 - 59.6
					Sample Date	8/24/2005	11/7/2005	1/25/2006	4/7/2006	6/7/2007	5/7/2008	5/10/2003	5/18/2005	6/14/2005	7/12/2005	8/24/2005	11/7/2005	1/25/2006	4/7/2006
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95(1))														
GENERAL	471-34-1	Alkalinity, total as CaCO3	μg/L	--	--	328000	248000	390000	370000	- -	- -	410000	370000	380000	390000	388000	385000	400000	405000
GENERAL	7664-41-7	Ammonia as nitrogen	μg/L	30000	--	- -	- -	- -	- -	- -	- -	400	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	μg/L	--	--	367000	1820000	499000	571000	- -	- -	60000	13000	250000	- -	430000	1910000	428000	822000
GENERAL	14265-44-2	Phosphate	μg/L	--	--	- -	- -	- -	- -	- -	- -	1000 U	- -	- -	20	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	μg/L	--	--	- -	- -	- -	- -	- -	- -	1000 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	μg/L	--	--	- -	- -	- -	- -	- -	- -	700	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	μg/L	--	--	540 B	1200	810 B	94800	- -	- -	1000 U	1000 U	1900	1000 U	860 B	540 B	500 U	700 B
ANIONS	16887-00-6	Chloride	μg/L	--	--	1000 U	6700	6500	14900	- -	- -	4000	4000	2000	2000	1000 U	5600	6100	6600
ANIONS	16984-48-8	Fluoride	μg/L	4000	--	450	360	470	280	- -	- -	- -	- -	500	500	480	510	470	460
ANIONS	14797-55-8	Nitrate as Nitrate	μg/L	10000	--	230	400	100	50 U	- -	- -	- -	200 U	200 U	200 U	50 U	50 U	290	50 U
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	μg/L	10000	--	- -	- -	- -	- -	- -	- -	60	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	μg/L	1000	--	50 U	50 U	90 B	50 U	- -	- -	- -	100 U	100 U	100 U	50 U	50 U	50 U	50 U
ANIONS	14808-79-8	Sulfate	μg/L	--	--	9700	25900	12600	13800	- -	- -	11000	10000	10000	9000	8000	13900	13200	12600
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	0.6 U	0.48 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.48 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	μg/L	1000	--	- -	- -	- -	- -	- -	- -	0.6 U	0.48 U	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	μg/L	2	--	- -	- -	- -	- -	- -	- -	0.6 U	0.48 U	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	μg/L	--	119033	- -	- -	- -	- -	- -	- -	80300	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	μg/L	14000	9736	7.5 U	7.5 U	75 U	3670	- -	- -	- -	106	33.2 B	18.3 B	7.5 U	7.5 U	940 B	1790
METALS	7439-95-4	Magnesium	μg/L	--	45243	- -	- -	- -	- -	- -	- -	31300	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	μg/L	430	580	*618*	346	*1240*	*2150*	- -	- -	- -	35.6	80.5	61.5	129	*450*	*651*	*467*
METALS	7440-23-5	Sodium	μg/L	--	42581	- -	- -	- -	- -	- -	- -	29100	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	μg/L	39	--	- -	- -	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	μg/L	1.5	--	- -	- -	- -	- -	- -	- -	5 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	μg/L	370	--	- -	- -	- -	- -	- -	- -	5 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	μg/L	75000	--	- -	- -	- -	- -	- -	- -	10 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	μg/L	6	--	- -	- -	- -	- -	- -	- -	5 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	μg/L	50	--	- -	- -	- -	- -	- -	- -	R	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	μg/L	1	--	- -	- -	- -	- -	- -	- -	5 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	108-95-2	Phenol	μg/L	5800	--	- -	- -	- -	- -	- -	- -	5 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	μg/L	200	--	- -	- -	- -	- -	100 U	- -	3 U	5 U	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	μg/L	10000	--	*83200*	*96400 E*	*53900*	*197000*	*312000*	*280000 J*	*14000*	6200 D	6300	7900	7440	7730	*55500*	*276000*
VOLATILES	75-34-3	1,1-Dichloroethane	μg/L	2.8	--	- -	- -	- -	- -	100 U	- -	3 U	5 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	μg/L	7	--	- -	- -	- -	- -	*535*	- -	3 U	5 U	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	μg/L	18000	--	- -	- -	- -	- -	2500 U	- -	10 U	25 U	- -	- -	- -	- -	- -	- -
VOLATILES	74-83-9	Bromomethane	μg/L	10	--	- -	- -	- -	- -	200 U	- -	3 U	5 U	- -	- -	- -	- -	- -	- -
VOLATILES	74-87-3	Chloro methane	μg/L	190	--	- -	- -	- -	- -	200 U	- -	3 U	5 U	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	μg/L	80	--	- -	- -	- -	- -	100 U	- -	2	5 U	- -	- -	- -	- -	- -	- -
VOLATILES	74-84-0	Ethane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	1.7 U	1.7 U	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	1.8 U	1.8 U	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	μg/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.62 J	0.87 J	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	μg/L	5600	--	- -	- -	- -	- -	252 J	- -	10 U	25 U	- -	- -	- -	- -	- -	- -
VOLATILES	75-09-2	Methylene chloride	μg/L	5	--	- -	- -	- -	- -	*149 JB*	- -	3 U	10 U	- -	- -	- -	- -	- -	- -
VOLATILES	1330-20-7	Xylenes, total	μg/L	10000	--	- -	- -	- -	- -	300 U	- -	3 U	7.5 U	- -	- -	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	L9-MW13			L9-MW13					L9-MW2			L9-MW3	L9-MW4	L9-MW5
					Sample ID	L9-MW13-20030510	L9-MW13	L9-MW13-140605	L9-MW13-01R2	L9-MW13-01R3	LL9-MW13-01R4	L9-MW13-02R1	L9-MW13-02R2	L9-MW2-20030512	FD02-041920	L9-MW2-0420	L9-MW3-20030507	L9-MW4-20030507	L9-MW5-20030508
					Sample Depth (ft)	79.5 - 84.5	79.5 - 84.5	79.5 - 84.5	79.5 - 84.5	79.5 - 84.5	79.5 - 84.5	79.5 - 84.5	79.5 - 84.5	93.8 - 98.8	93.8 - 98.8	93.8 - 98.8	13.5 - 28.5	54.3 - 64.3	9.4 - 24.4
					Sample Date	5/10/2003	5/18/2005	6/14/2005	7/12/2005	8/24/2005	11/9/2005	1/25/2006	4/10/2006	5/12/2003	4/19/2020	4/19/2020	5/7/2003	5/7/2003	5/8/2003
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])														
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	440000	420000	420000	430000	443000	300000	438000	438000	410000	- -	- -	310000	500000	180000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	610	- -	- -	- -	- -	- -	- -	- -	530	- -	- -	20 U	300	20 U
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	45000	19000	90000	- -	460000	330000	458000	501000	- -	- -	- -	- -	- -	40000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	- -	- -	170	- -	- -	- -	- -	1000 U	- -	- -	1000 U	1000 U	1000 U
GENERAL	18496-25-8	Sulfide	µg/L	--	--	3000	- -	- -	- -	- -	- -	- -	- -	1000 U	- -	- -	1000 U	1000 U	1000 U
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	1000	- -	- -	- -	- -	- -	- -	- -	1700	- -	- -	600	1100	500
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1500	1200	1400	1000	750 B	760 B	710 B	1300	3900	- -	- -	1000 U	1000 U	1000 U
ANIONS	16887-00-6	Chloride	µg/L	--	--	2000	2000	2000	1000	1000 U	5600	5900	6400	28000	- -	- -	3000	1000	9000
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	500	400	440	420	430	320	- -	- -	- -	- -	- -	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	200 U	200 U	200 U	50 U	50 U	50 U	50 U	- -	- -	- -	- -	- -	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	380	- -	- -	- -	- -	- -	- -	- -	50 U	- -	- -	2700	50 U	3400
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	100 U	100 U	100 U	50 U	50 U	50 U	50 U	- -	- -	- -	- -	- -	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	3000	1000 U	1000	1000	1600 B	8300	8300	7500	43000	- -	- -	49000	30000	41000
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.2 U	0.48 U	- -	- -	- -	- -	- -	- -	1.1 U	- -	- -	0.3 U	0.74 U	0.57 U
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	0.48 U	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.2 U	0.48 U	- -	- -	- -	- -	- -	- -	1.1 U	- -	- -	0.3 U	0.74 U	0.57 U
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.2 U	0.48 U	- -	- -	- -	- -	- -	- -	1.1 U	- -	- -	0.3 U	0.74 U	0.57 U
METALS	7440-70-2	Calcium	µg/L	--	119033	84700	- -	- -	- -	- -	- -	- -	- -	79600	- -	- -	70500	105000	43000
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	4190	3450	3410	3950	3240	3900	3960	- -	- -	- -	- -	- -	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	34200	- -	- -	- -	- -	- -	- -	- -	29700	- -	- -	32000	36700	18300
METALS	7439-96-5	Manganese	µg/L	430	580	- -	166	131	124	132	127	106 B	108	- -	- -	- -	- -	- -	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	29000	- -	- -	- -	- -	- -	- -	- -	44100	- -	- -	17400	32500	11200
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	10 U	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -	10 U	10 U	10 U
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	5 U	- -	- -	- -	- -	- -	- -	- -	5 U	- -	- -	5 U	5 U	5 U
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	5 U	- -	- -	- -	- -	- -	- -	- -	5 U	- -	- -	5 U	5 U	5 U
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	10 U	- -	- -	- -	- -	- -	- -	- -	10 U	- -	- -	10 U	10 U	10 U
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	5 U	- -	- -	- -	- -	- -	- -	- -	2	- -	- -	5 U	5 U	5 U
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	R	- -	- -	- -	- -	- -	- -	- -	5 U	- -	- -	5 U	R	5 U
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	5 U	- -	- -	- -	- -	- -	- -	- -	5 U	0.029 U	0.028 UJ	5 U	5 U	5 U
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	5 U	- -	- -	- -	- -	- -	- -	- -	5 U	- -	- -	5 U	5 U	5 U
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	1 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -	3 U	3 U	3 U
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	20	14	33	190	5.5	12.9	66.3	106	26	- -	- -	2	2	10
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	1 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -	3 U	3 U	3 U
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	1 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -	3 U	3 U	3 U
VOLATILES	67-64-1	Acetone	µg/L	18000	--	10 U	5 U	- -	- -	- -	- -	- -	- -	10 U	- -	- -	10 U	10 U	10 U
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	3 U	1 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -	3 U	3 U	3 U
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	3 U	1 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -	3 U	3 U	3 U
VOLATILES	67-66-3	Chloroform	µg/L	80	--	3 U	1 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -	3 U	3 U	3 U
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	9.2	7.3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	19	7.4	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	85	65	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	10 U	5 U	- -	- -	- -	- -	- -	- -	10 U	- -	- -	10 U	10 U	10 U
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	3 U	2 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -	3 U	3 U	3 U
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	2	1.5 U	- -	- -	- -	- -	- -	- -	3 U	- -	- -	3 U	3 U	3 U

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	L9-MW6	L9-MW7	L9-MW8	L9-MW9				LL9-TT-MW01			
					Sample ID	L9-MW6-20030508	L9-MW7-20030510	L9-MW8-20030508	L9-MW9-20030509	LL9-TT-MW1	LL9-TT-MW01-160605	LL9-TT-MW1-01R3	LL9-TT-MW1-01R4	LL9-TT-MW1-02R1	LL9-TT-MW1-02R2	LL9-TT-MW1-02R2B
					Sample Depth (ft)	50 - 60	13.9 - 28.9	46.5 - 56.5	12.2 - 27.2	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25
					Sample Date	5/8/2003	5/10/2003	5/8/2003	5/9/2003	5/18/2005	6/16/2005	8/24/2005	11/10/2005	1/26/2006	4/11/2006	4/12/2006
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])											
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	440000	280000	340000	280000	260000	250000	78800	295000	295000	246000	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	300	70	880	20 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	95000	42000	- -	70000	2000000	32000	90100	535000	422000	362000	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	1000 U	1000 U	- -	1000 U	- -	- -	- -	- -	- -	210	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	1000 U	1000 U	1000 U	1000 U	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	900	300 U	2100	500	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1000 U	1200	4900	1000 U	1200	1300	890 B	960 B	700 B	710 B	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	1000	5000	31000	8000	12000	14000	8100	13300	11100	12000	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	- -	- -	- -	- -	400	400	290	280	360	370	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	- -	- -	- -	- -	300	400	380	370	170	240	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	50 U	120	270	620	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	- -	- -	- -	- -	100 U	100 U	50 U	50 U	50 U	50 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	34000	41000	- -	51000	32000	36000	39200	34200	24700	28700	- -
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	1.2 U	0.61 U	1.5 U	0.86 U	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	1.2 U	0.61 U	1.5 U	0.86 U	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	1.2 U	0.61 U	1.5 U	0.86 U	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	92300	66900	80700	67200	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	- -	- -	- -	*105000*	3660	5380	1610	*50700*	- -	*17600*
METALS	7439-95-4	Magnesium	µg/L	--	45243	34600	23800	26800	28700	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	- -	- -	- -	*3920*	*561*	303	139	*2380*	- -	*900*
METALS	7440-23-5	Sodium	µg/L	--	42581	25400	22000	*52800*	13200	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	10 U	10 U	R	R	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	5 U	R	R	R	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	5 U	5 U	5 U	5 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	3 U	3 U	3 U	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	2	3 U	3 U	3 U	9800 D	3600	3550	5490	*32600*	*12200*	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	3 U	3 U	3 U	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	3 U	3 U	3 U	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	10 U	10 U	6	10 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	3 U	3 U	3 U	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	3 U	3 U	3 U	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	3 U	3 U	3 U	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-84-0	Ethane	µg/L	--	--	- -	- -	- -	- -	1.7 U	1.7 U	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	- -	- -	- -	- -	1.8 U	1.8 U	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	- -	- -	- -	- -	2.8	2.4	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	10 U	10 U	10 U	10 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	3 U	3 U	3 U	3 U	- -	- -	- -	- -	- -	- -	- -
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	3 U	3 U	3 U	3 U	- -	- -	- -	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location	LL9-TT-MW02					LL9-TT-MW02		
					Sample ID	LL9-TT-MW2-190505	LL9-TT-MW2-190505A	L9-TT-MW02-160605	LL9-TT-MW2-01R3	LL9-TT-MW2-01R4	LL9-TT-MW2-02R1	LL9-TT-MW2-02R2	L9TTMW02-0418
					Sample Depth (ft)	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25
					Sample Date	5/18/2005	5/19/2005	6/16/2005	8/24/2005	11/9/2005	1/23/2006	4/10/2006	4/21/2018
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])								
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	260000	- -	460000	150000	315000	858000	308000	- -
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	220000	- -	720000	6700000	3160000	2940000	1500000	- -
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	2600	- -	45000000	5770000	75000 U	2460000	1030000	- -
ANIONS	16887-00-6	Chloride	µg/L	--	--	12000	- -	11000	10000 U	48200	12500	14900	- -
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	400	- -	200 U	*9300*	1000 U	100 U	100 U	- -
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	2700	- -	200 U	500 U	500 U	50 U	50 U	- -
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	100 U	- -	100 U	500 U	500 U	50 U	50 U	- -
ANIONS	14808-79-8	Sulfate	µg/L	--	--	40000	- -	38000	25200	28900	9800	12800	- -
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.0018 U
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00052 J
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00091 U
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00047 U
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.00032 U
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.0028 U
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	0.013 U
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	- -	106000 N	*12400*	*96700*	*66100*	*37900*	*34300*	- -
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	- -	*1100*	*9760*	*44200*	*40900*	*14000*	*41200*	- -
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	- -	- -	- -	- -	- -	- -	- -	0.62
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	*13000 D*	- -	*14000*	1430	*12900*	*64600*	*65300*	- -
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-84-0	Ethane	µg/L	--	--	1.7 U	- -	1.4 J	- -	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	1.8 U	- -	0.65 J	- -	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	0.49 J	- -	1.1	- -	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9

Iowa Army Ammunition Plant, Middletown, IA

					Location			LL9-TT-MW03					LL9-TT-MW04			LL9-TT-MW04	
					Sample ID	LL9-TT-MW3	L9-TT-MW03-160605	LL9-TT-MW3-01R3	LL9-TT-MW3-01R4	LL9-TT-MW3-02R1	LL9-TT-MW3-02R2	LL9-TT-MW4	LL9-TT-MW04-160605	LL9-TT-MW4-01R3	LL9-TT-MW4-01R4	LL9-TT-MW4-02R1	LL9-TT-MW4-02R2
					Sample Depth (ft)	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25	5 - 25
					Sample Date	5/19/2005	6/16/2005	8/24/2005	11/9/2005	1/23/2006	4/10/2006	5/18/2005	6/16/2005	8/24/2005	11/9/2005	1/26/2006	4/10/2006
Test Group	CAS	Analyte	Unit	Screening Level*	Background Threshold Value (UTL95-95[1])												
GENERAL	471-34-1	Alkalinity, total as CaCO3	µg/L	--	--	250000	320000	150000	600000	2500 U	393000	290000	320000	345000	227000	181000	149000
GENERAL	7664-41-7	Ammonia as nitrogen	µg/L	30000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	124-38-9	Carbon dioxide	µg/L	--	--	16000	87000	6120000	4590000	5000 U	10900000	18000	52000	377000	500000	282000	436000
GENERAL	14265-44-2	Phosphate	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	18496-25-8	Sulfide	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	TKN	Total Kjeldahl Nitrogen	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL	7440-44-0	Total organic carbon	µg/L	--	--	1900	36000000	5160000	75000 U	1650000	766000	1200	1300	2800	500 U	1300	1700
ANIONS	16887-00-6	Chloride	µg/L	--	--	12000	12000	10000 U	47400	16800	10000 U	4000	2000	1000 U	5500	7400	8200
ANIONS	16984-48-8	Fluoride	µg/L	4000	--	400	200 U	*6400*	*33700*	100 U	1000 U	400	400	380	440	260	320
ANIONS	14797-55-8	Nitrate as Nitrate	µg/L	10000	--	2500	200 U	500 U	500 U	50 U	50 U	600	200 U	50 U	80 B	920	560
ANIONS	NO3NO2N	Nitrate/Nitrite as Nitrogen	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
ANIONS	14797-65-0	Nitrite as Nitrogen	µg/L	1000	--	100 U	200 U	500 U	500 U	100 U	500 U	100 U	100 U	50 U	80 B	120	50 U
ANIONS	14808-79-8	Sulfate	µg/L	--	--	34000	35000	27900	11400	23400	14700	15000	11000	6900	12800	28900	35100
DIOXINS	67562-39-4	1,2,3,4,6,7,8-HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57653-85-7	1,2,3,6,7,8-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	57117-44-9	1,2,3,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	19408-74-3	1,2,3,7,8,9-HxCDD	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	60851-34-5	2,3,4,6,7,8-HxCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	39001-02-0	OCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DIOXINS	38998-75-3	Total HpCDF	ng/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	5755-27-1	MNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	DNX	DNX	µg/L	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	2691-41-0	HMX	µg/L	1000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
EXPLOSIVES	121-82-4	RDX	µg/L	2	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7440-70-2	Calcium	µg/L	--	119033	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-89-6	Iron	µg/L	14000	9736	22800 N	5500	*119000*	*49700*	*25500*	*11300*	*95900*	*96400*	*26800*	793	4680	2820
METALS	7439-95-4	Magnesium	µg/L	--	45243	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
METALS	7439-96-5	Manganese	µg/L	430	580	*885*	*4500*	*22000*	*24500*	*15500*	*18600*	*1100*	*1320*	*754*	*601*	88.9	80.8
METALS	7440-23-5	Sodium	µg/L	--	42581	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	51-28-5	2,4-Dinitrophenol	µg/L	39	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	534-52-1	4,6-Dinitro-2-methylphenol	µg/L	1.5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	106-44-5	4-Methylphenol	µg/L	370	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	65-85-0	Benzoic acid	µg/L	75000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	117-81-7	bis (2-ethylhexyl) phthalate	µg/L	6	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	77-47-4	Hexachlorocyclopentadiene	µg/L	50	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	87-86-5	Pentachlorophenol	µg/L	1	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
SEMIVOLATILES	108-95-2	Phenol	µg/L	5800	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	71-55-6	1,1,1-Trichloroethane	µg/L	200	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	10000	--	*25000 D*	*14000*	3470	6180	*80500*	*91000*	*52000 D*	*120000*	*83400*	*96000 E*	*62700*	*66000*
VOLATILES	75-34-3	1,1-Dichloroethane	µg/L	2.8	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-35-4	1,1-Dichloroethene	µg/L	7	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-64-1	Acetone	µg/L	18000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-83-9	Bromomethane	µg/L	10	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-87-3	Chloro methane	µg/L	190	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	67-66-3	Chloroform	µg/L	80	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	74-84-0	Ethane	µg/L	--	--	1.7 U	1 J	- -	- -	- -	- -	0.77 J	1.2 J	- -	- -	- -	- -
VOLATILES	74-85-1	Ethene	µg/L	--	--	1.8 U	1.8 U	- -	- -	- -	- -	1.8 U	1.8 U	- -	- -	- -	- -
VOLATILES	74828	Methane	µg/L	--	--	0.87 U	1.1	- -	- -	- -	- -	0.65 J	1.4	- -	- -	- -	- -
VOLATILES	78-93-3	Methyl ethyl ketone	µg/L	5600	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	75-09-2	Methylene chloride	µg/L	5	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
VOLATILES	1330-20-7	Xylenes, total	µg/L	10000	--	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 5.8-4. Detected Chemicals in Groundwater—Line 9
Iowa Army Ammunition Plant, Middletown, IA

Notes:

DNX = 1,3-Dinitro-5-nitroso-1,3,5-triazinane

HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazocane

MNX = 1,8-DI-Hydroxy-4-nitro-xanthen-9-one

RDX = 1,3,5-trinitro-1,3,5-triazine

B = The analyte was detected in the associated method and/or calibration blank.

D = Diluted sample.

E = Sample result over the calibration range, considered an estimated result.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

JB = The analyte detected in the associated field, equipment, and/or trip blank.

N = The analysis indicates the presence of an analyte for which there was presumptive evidence to make a tentative identification.

P = Sample failed confirmation precision criteria.

R = The sample results are rejected due to serious deficiencies in the ability to analyze the sample and to meet the quality control criteria. The presence or absence of the analyte cannot be verified.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

-- = Not Analyzed

ng/l = Nanograms per Liter

µg/L = Micrograms per Liter

Bold indicates the analyte was detected

Italics indicates the result exceeded screening criteria

Shading indicates the result exceeded screening criteria and background value, if applicable.

*Screening level is the MCL. If no MCL is available, the greater of the HAL and the tap water RSL is selected as the delineation screening level.

MCL = Maximum Contaminant Level

Source: EPA's Regional Screening Levels (May 2022). Available online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Source: EPA's MCLs and HALs (March 2018). Available online: https://www.epa.gov/sdwa/2018-drinking-water-standards-and-advisory-tables.

Source: Background threshold values (BTVs) from Evaluation of Background Concentrations of Metals in Groundwater (CH2M 2020a)

(1) UTLs were calculated as 95% upper confidence bounds of the 95th percentiles of the background data. UTLs calculated without a definitive distributional assumption of the data (i.e., normal, gamma, or lognormal) for sample sizes less than 59 have a coverage probability less than 95%.

Table 5.8-5. Groundwater Quality Parameters—Line 9

Iowa Army Ammunition Plant, Middletown, IA

Sample Location	Sample Date	Depth to Water (ft btoc)	pH (pH Units)	Temperature (°C)	Conductivity (uS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
JAW-29	4/22/2018	6.64	7.26	11.54	589	190	1.7	323
JAW-30	4/20/2018	7.32	6.92	11.63	526	110	4.03	5.26
JAW-31	4/20/2018	6.52	6.96	11.17	635	139.7	3.95	6.41
L9-MW1	4/21/2018	11.79	7.02	12.48	704	61.2	1.27	39.4
L9-MW2	12/15/2019	11.82	7.54	9.17	82	-24.2	4.11	overrange
L9-MW2	4/19/2020	11.82	7.45	12.1	620	118.8	4.12	2.33
L9-TT-MW02	4/20/2018	4.92	6.39	11.23	517	33.1	3.72	4.31

Notes:

Water quality parameters were measured in the field using a YSI multi-meter.

All wells were gauged in April 2018. L9-MW2 was sampled at a later date.

°C = degrees Celsius

DO = dissolved oxygen

mV = millivolt(s)

NTU = nephelometric turbidity unit

ORP = oxidation-reduction potential

ug/L = microgram(s) per liter

uS/cm = microsiemen(s) per centimeter

ft = feet

btoc = below top of casing

Table 5.8-7. Data Groupings Used in the HHRA - Line 9

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Description	Sample Count
AOC_GW	Groundwater	84
AOC_GW-CW	Groundwater in trench/culvert	23

Table 5.8-8. Samples Used in the HHRA - Line 9

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW	AOC_GW-CW	WG	JAW-29	JAW-29-20030520	5/20/2003 (2)	9	19
AOC_GW	AOC_GW-CW	WG	JAW-29	F04-GW-059	11/17/2004	9	19
AOC_GW	AOC_GW-CW	WG	JAW-29	S07-JAW-29-GW-REG	6/6/2007	9	19
AOC_GW	AOC_GW-CW	WG	JAW-29	S08-JAW-29-GW-REG	5/6/2008	9	19
AOC_GW	AOC_GW-CW	WG	JAW-29	JAW29-0418	4/22/2018	9	19
AOC_GW	AOC_GW-CW	WG	JAW-30	JAW-30-20030519	5/19/2003 (2)	9	19
AOC_GW	AOC_GW-CW	WG	JAW-30	F04-GW-061	11/17/2004	9	19
AOC_GW	AOC_GW-CW	WG	JAW-30	S07-JAW-30-GW-REG	6/7/2007	9	19
AOC_GW	AOC_GW-CW	WG	JAW-30	S08-JAW-30-GW-REG	5/6/2008	9	19
AOC_GW	AOC_GW-CW	WG	JAW-30	JAW30-0418	4/20/2018	9	19
AOC_GW	AOC_GW-CW	WG	JAW-31	JAW-31-20030519	5/19/2003 (2)	9	19
AOC_GW	AOC_GW-CW	WG	JAW-31	F04-GW-062	11/17/2004	9	19
AOC_GW	AOC_GW-CW	WG	JAW-31	S07-JAW-31-GW-REG	6/6/2007	9	19
AOC_GW	AOC_GW-CW	WG	JAW-31	S08-JAW-31-GW-REG	5/7/2008	9	19
AOC_GW	AOC_GW-CW	WG	JAW-31	JAW-31-082010	8/20/2010	9	19
AOC_GW	AOC_GW-CW	WG	JAW-31	JAW31-0418	4/20/2018	9	19
AOC_GW		WG	JAW-610	JAW-610-20030518	5/18/2003 (2)	8	18
AOC_GW		WG	JAW-611	JAW-611-20030519	5/19/2003 (2)	6.5	16.5
AOC_GW		WG	JAW-612	JAW-612-20030518	5/18/2003 (2)	6.5	16.5
AOC_GW		WG	L9-MW1	L9-MW1-20030511	5/11/2003 (2)	55	65
AOC_GW		WG	L9-MW1	L9MW1-0418	4/21/2018	55	65
AOC_GW		WG	L9-MW10	L9-MW10-20030509	5/9/2003 (2)	51.4	61.4
AOC_GW		WG	L9-MW11	L9-MW11-20030511	5/11/2003 (2)	14.5	29.5
AOC_GW		WG	L9-MW11	F04-GW-058	11/16/2004	14.5	29.5
AOC_GW		WG	L9-MW11	L9-MW11	5/18/2005	14.5	29.5
AOC_GW		WG	L9-MW11	L9-MW11-140605	6/14/2005	14.5	29.5
AOC_GW		WG	L9-MW11	L9-MW11-01R2	7/12/2005	14.5	29.5
AOC_GW		WG	L9-MW11	L9-MW11-01R3	8/24/2005	14.5	29.5
AOC_GW		WG	L9-MW11	L9-MW11-01R4	11/7/2005	14.5	29.5
AOC_GW		WG	L9-MW11	L9-MW11-02R1	1/25/2006	14.5	29.5
AOC_GW		WG	L9-MW11	L9-MW11-02R2	4/7/2006	14.5	29.5
AOC_GW		WG	L9-MW11	S07-L9-MW11-GW-REG	6/7/2007	14.5	29.5
AOC_GW		WG	L9-MW11	S08-L9-MW11-GW-REG	5/7/2008	14.5	29.5

Table 5.8-8. Samples Used in the HHRA - Line 9

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW		WG	L9-MW12	L9-MW12-20030510	5/10/2003 (2)	49.6	59.6
AOC_GW		WG	L9-MW12	L9-MW12	5/18/2005	49.6	59.6
AOC_GW		WG	L9-MW12	L9-MW12-140605	6/14/2005	49.6	59.6
AOC_GW		WG	L9-MW12	L9-MW12-01R2	7/12/2005	49.6	59.6
AOC_GW		WG	L9-MW12	L9-MW12-01R3	8/24/2005	49.6	59.6
AOC_GW		WG	L9-MW12	L9-MW12-01R4	11/7/2005	49.6	59.6
AOC_GW		WG	L9-MW12	L9-MW12-02R1	1/25/2006	49.6	59.6
AOC_GW		WG	L9-MW12	L9-MW12-02R2	4/7/2006	49.6	59.6
AOC_GW		WG	L9-MW13	L9-MW13-20030510	5/10/2003 (2)	79.5	84.5
AOC_GW		WG	L9-MW13	L9-MW13	5/18/2005	79.5	84.5
AOC_GW		WG	L9-MW13	L9-MW13-140605	6/14/2005	79.5	84.5
AOC_GW		WG	L9-MW13	L9-MW13-01R2	7/12/2005	79.5	84.5
AOC_GW		WG	L9-MW13	L9-MW13-01R3	8/24/2005	79.5	84.5
AOC_GW		WG	L9-MW13	LL9-MW13-01R4	11/9/2005	79.5	84.5
AOC_GW		WG	L9-MW13	L9-MW13-02R1	1/25/2006	79.5	84.5
AOC_GW		WG	L9-MW13	L9-MW13-02R2	4/10/2006	79.5	84.5
AOC_GW		WG	L9-MW2	L9-MW2-20030512	5/12/2003 (2)	93.8	98.8
AOC_GW		WG	L9-MW2	L9-FW02-1219	12/15/2019	93.8	98.8
AOC_GW		WG	L9-MW2	L9-MW2-0420	4/19/2020	93.8	98.8
AOC_GW		WG	L9-MW3	L9-MW3-20030507	5/7/2003 (2)	13.5	28.5
AOC_GW		WG	L9-MW4	L9-MW4-20030507	5/7/2003 (2)	54.3	64.3
AOC_GW		WG	L9-MW5	L9-MW5-20030508	5/8/2003 (2)	9.4	24.4
AOC_GW		WG	L9-MW6	L9-MW6-20030508	5/8/2003 (2)	50	60
AOC_GW		WG	L9-MW7	L9-MW7-20030510	5/10/2003 (2)	13.9	28.9
AOC_GW		WG	L9-MW8	L9-MW8-20030508	5/8/2003 (2)	46.5	56.5
AOC_GW		WG	L9-MW9	L9-MW9-20030509	5/9/2003 (2)	12.2	27.2
AOC_GW		WG	LL9-TT-MW01	LL9-TT-MW1	5/18/2005	5	25

Table 5.8-8. Samples Used in the HHRA - Line 9

Iowa Army Ammunition Plant, Middletown, Iowa

Data Group ID for HHRA	Data Group ID for HHRA	Matrix	Station ID	Sample ID (1)	Date Collected	Upper Depth (Feet)	Lower Depth (Feet)
AOC_GW		WG	LL9-TT-MW01	L9-TT-MW01-160605	6/16/2005	5	25
AOC_GW		WG	LL9-TT-MW01	LL9-TT-MW1-01R3	8/24/2005	5	25
AOC_GW		WG	LL9-TT-MW01	LL9-TT-MW1-01R4	11/10/2005	5	25
AOC_GW		WG	LL9-TT-MW01	LL9-TT-MW1-02R1	1/26/2006	5	25
AOC_GW		WG	LL9-TT-MW01	LL9-TT-MW1-02R2	4/11/2006	5	25
AOC_GW	AOC_GW-CW	WG	LL9-TT-MW02	LL9-TT-MW2-190505	5/18/2005	5	25
AOC_GW	AOC_GW-CW	WG	LL9-TT-MW02	L9-TT-MW02-160605	6/16/2005	5	25
AOC_GW	AOC_GW-CW	WG	LL9-TT-MW02	LL9-TT-MW2-01R3	8/24/2005	5	25
AOC_GW	AOC_GW-CW	WG	LL9-TT-MW02	LL9-TT-MW2-01R4	11/9/2005	5	25
AOC_GW	AOC_GW-CW	WG	LL9-TT-MW02	LL9-TT-MW2-02R1	1/23/2006	5	25
AOC_GW	AOC_GW-CW	WG	LL9-TT-MW02	LL9-TT-MW2-02R2	4/10/2006	5	25
AOC_GW	AOC_GW-CW	WG	LL9-TT-MW02	L9TTMW02-0418	4/21/2018	5	25
AOC_GW		WG	LL9-TT-MW03	LL9-TT-MW3	5/19/2005	5	25
AOC_GW		WG	LL9-TT-MW03	L9-TT-MW03-160605	6/16/2005	5	25
AOC_GW		WG	LL9-TT-MW03	LL9-TT-MW3-01R3	8/24/2005	5	25
AOC_GW		WG	LL9-TT-MW03	LL9-TT-MW3-01R4	11/9/2005	5	25
AOC_GW		WG	LL9-TT-MW03	LL9-TT-MW3-02R1	1/23/2006	5	25
AOC_GW		WG	LL9-TT-MW03	LL9-TT-MW3-02R2	4/10/2006	5	25
AOC_GW		WG	LL9-TT-MW04	LL9-TT-MW4	5/18/2005	5	25
AOC_GW		WG	LL9-TT-MW04	L9-TT-MW04-160605	6/16/2005	5	25
AOC_GW		WG	LL9-TT-MW04	LL9-TT-MW4-01R3	8/24/2005	5	25
AOC_GW		WG	LL9-TT-MW04	LL9-TT-MW4-01R4	11/9/2005	5	25
AOC_GW		WG	LL9-TT-MW04	LL9-TT-MW4-02R1	1/26/2006	5	25
AOC_GW		WG	LL9-TT-MW04	LL9-TT-MW4-02R2	4/10/2006	5	25

Notes:

(1) The data were reduced such that when a normal and duplicate sample were available, the highest detected concentration among normal or duplicate samples was used when a chemical was detected in any sample. If both results were non-detect, the lowest reported detection limit (i.e., reporting limit) was used.

(2) Only explosives data from this sample were used in the evaluation because more recent data were available for the other analytes (SVOCs and VOCs).

WG = groundwater

SVOC = semivolatile organic compound

VOC = volatile organic compound