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 4)

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Prepared for

U.S. Army Corps of Engineers
Louisville District

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

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Title and Approval Page

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Preparer's Contact Information:	Leidos, Inc. 13397 Lakefront Drive, Suite 100 Earth City, Missouri Telephone: 314-770-3077 E-mail: matthew.p.bange@leidos.com
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Jennifer Busard, IAAAP — Date
Environmental Restoration Program Manager

1/29/2019

Daniel O'Connor, USEPA — Date
U.S. Environmental Protection Agency Remedial Project Manager

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Aaron Steele, USACE — Date
Contracting Officers Representative

January 18, 2019

Matthew Vest, Leidos — Date
Project Manager

January 18, 2019

Stefanie Kraml, Leidos — Date
Project Chemist

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STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Environmental Services at Iowa Army Ammunition Plant
Middletown, Iowa

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT

The CH2M team has completed the Final submittal of the site-specific Worksheets (Packet 4) that are attachments to the **Uniform Federal Policy–Quality Assurance Project Plan for Remedial Investigation at Iowa Army Ammunition Plant, Middletown, Iowa: Site-specific Worksheets (Packet 4)**. Notice is hereby given that an independent technical review (ITR) has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Project Management Plan and Contractor Quality Control Plan. During the ITR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures and material used in analyses; the appropriateness of data used and level of data obtained; and reasonableness of the results including whether the product meets the USACE's needs consistent with the law and existing USACE policy.

Leidos Project Manager	**Leidos ITR Team Leader**
01/18/2019	01/18/2019
Signature Date	Signature Date
Matthew Vest	Matthew Bange

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1	November 20, 2018	Draft Final to USEPA
2	January 18, 2019	Final to USEPA

Site-specific Worksheets for OU6 (Packet 4)

Inert Disposal Area Worksheet #10: Conceptual Site Model

This worksheet describes the site-specific background and environmental problem in relation to the conceptual site model (CSM) for the Inert Disposal Area (IDA) (Site IAAP-020) and IDA Groundwater (Site IAAP-020G). The CSM integrates existing information and assumptions about the physical site conditions, operational history, and characteristics of chemicals of concern (COCs) based on historical reports. The CSM is based on the current understanding of site history and conditions, and will be updated in the future based on information from the supplemental remedial investigation (SRI) activities being conducted under this Quality Assurance Project Plan (QAPP).

Background

This background section consists of the site description and operational history.

Site Description

The IDA, collectively designated operable unit (OU)-4, encompasses approximately 20 acres and includes the Inert Landfill (ILF) Trenches 1-5, Cap Extension Area (CEA), Trench 6, Trench 7 (Corrective Action Management Unit [CAMU]), and the associated sedimentation ponds (Figure IDA-10-1). Trench 6 is divided into two areas, Trench 6 North and Trench 6 Landfill (also known as the Soil Repository). The Iowa Army Ammunition Plant (IAAAP) conducted waste management operations, including landfilling, at the IDA from 1941 until 2011. The ILF Trenches 1-5 and Trench 6 North received waste materials such as residential and cafeteria refuse, plastic, tin cans, scrap lumber, and unsalvageable paper and cardboard until the mid-1990s. Trench 6 Landfill was originally intended to receive sanitary wastes, but was never utilized for sanitary waste disposal.

Wastes were also disposed and managed in other areas of the IDA (i.e., Former Blue Sludge Lagoon, Former Holding Pond/Sludge Drying Bed, Former Burning Ground, and Former Metal Storage Yard) located immediately southeast of the ILF (Figure IDA-10-1). The Former Blue Sludge Lagoon was a surface impoundment that received chromium hydroxide sludge generated at Lines 3 and 800 during metal cleaning operations. In 1984 the contents of the lagoon and underlying soil were excavated and placed in the adjacent concrete-lined Former Holding Pond/Sludge Drying Bed. Salvageable metals- and explosives-contaminated wastes were flash-burned at the Former Burning Ground before the contaminated waste processor became operational at the facility in 1982. The Former Metal Storage Yard was used to store scrap lumber, metal, used railroad ties, paper, cardboard, etc. for eventual sale to the public.

From 1980 to 1983, a northern portion of Trench 5 (also known as the Ash Disposal Cell) received Resource Conservation and Recovery Act (RCRA) hazardous wastes, such as ash from the open burning of explosives and explosives-contaminated waste, the contaminated waste processor, and the explosive waste incinerator. From 1998 to 2007, the Trench 6 Landfill (Soil Repository), Trench 7, and the CEA only received contaminated soils from Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) OU1 remediation activities. Closure activities at the ILF Trenches 1-5, CEA, Trench 6, Trench 7, and the RCRA Ash Disposal Cell occurred from 1989 to 2011, as discussed in the following Operational History section.

The site is surrounded by vacant land with vegetation and trees. There is currently no residential or commercial land use in the immediate vicinity of the site (USACE, 2007) with the exception of limited industrial use (railroad tracks) north of the IDA. An office is located at the IDA and is used by maintenance workers. The IAAAP Firing Sites Area (IAAP-030) is located southwest of the IDA and is regularly used by IAAAP personnel.

Operational History

The operational history and current status of the IDA is summarized as follows.

- 1940s – 1990s: ILF Trenches 1-5 and Trench 6 North received residential and industrial wastes.
- 1980 – 1983: Northern portion of Trench 5 received RCRA hazardous waste.
- 1989: Northern portion of Trench 5 of the ILF closed with a clay cover under RCRA Subtitle C requirements (USACE, 1988).
- 1992 – 1998: CERCLA process for OU1 sites (i.e., remedial investigation [RI], feasibility study [FS], proposed plan [PP], record of decision [ROD]) including a baseline risk assessment that provided the basis for the OU4 disposal criteria associated with the OU1 response actions.
- 1994 – Present: RCRA Long-term monitoring (LTM) and management program in accordance with the March 1994 RCRA Consent Agreement and Consent Order (CA/CO) (USEPA, 1994) issued by the United States Environmental Protection Agency (USEPA) and pursuant to the IDA 1988 closure and post-closure monitoring plan (USEPA, 1988).
- 1996: Unfilled Trench 6 Landfill and Trench 7 approved to be converted to Subtitle C-equivalent storage units to receive future excavated soils; USEPA designated Trench 7 as CAMU (USEPA, 1996).
- 1997: ILF Trenches 1-5 (random fill material to achieve grade before capping) and CEA received contaminated soil from CERCLA remedial actions at IAAAP OU1 sites (CDM, 1997).
- 1997: Removal of IDA Burning Ground and Blue Sludge Lagoon areas (ECC, 2001).
- 1998: ILF Trenches 1-5 (including the previously closed Northern portion of Trench 5) capped and closed with a synthetic cover system (Tetra Tech, 2011b).
- 1998 – 2007: Trench 6 Landfill, Trench 7, and CEA received contaminated soil from CERCLA remedial actions at IAAAP OU1 sites.
- 2008: OU4 Interim Record of Decision (IROD) for Trench 6, Trench 7, and the CEA of the IDA presented a closure plan to: treat contaminated soils in Trench 7 and subsequently remove and transfer contents to Trench 6 Landfill; close Trench 6 Landfill and CEA pursuant to RCRA Subtitle C cover requirements; and groundwater monitoring of the CERCLA remedial actions (Tetra Tech, 2008b).
- 2008 – Present: CERCLA LTM following 2008 OU4 IROD (Tetra Tech, 2008b).
- 2009: Trench 7 soils treated via alkaline hydrolysis and all Trench 7 contents including liner were removed and transferred to Trench 6 Landfill. No further action necessary at Trench 7 (Tetra Tech 2012).
- 2010: CEA capped and closed under RCRA Subtitle C cover requirements per the 2008 OU4 IROD (Tetra Tech, 2011b).
- 2011: Trench 6 North and Trench 6 Landfill capped and closed with synthetic cover under RCRA Subtitle C cover requirements per the 2008 OU4 IROD (Tetra Tech, 2012).
- 2016: Boundary fence (42-inch chain link fence) installed at the IDA encompassing Trench 6 North, Trench 6 Landfill, ILF, and CEA (Aerostar, 2016).

Residential and industrial wastes were disposed in Trenches 1-5 and Trench 6 North including disposal of RCRA hazardous waste in the northern portion of Trench 5. The trench and fill method of landfill operation was employed at the IAAAP. To begin the operation of a new trench, the entire length of the trench was first excavated to an approximate depth of 25 feet below ground surface (bgs); excavated material was stockpiled alongside the trench and used as daily and final cover (USACE, 1988). RCRA hazardous wastes, consisting of ash from incineration of explosives, were also disposed in the northern portion of Trench 5. Between 1998 and 2007, OU1 remedial actions resulted in the excavation of approximately211,000 cubic yards (yd^3) of contaminated soil, which was taken to the Trench 6 Landfill, Trench 7, and the CEA for disposal or taken to the ILF to be used as base grade for the ILF cap (USACE, 2007). Highly contaminated soils (cumulative risk greater than 10^{-5}) were considered a principal threat and stored in Trench 7, which was designated as a CAMU, for treatment prior to final disposal. Moderately contaminated soils (cumulative risk between 10^{-5} and 10^{-6}) and low level contaminated soils (cumulative risk less than 10^{-6}) were considered to present a low-level threat and therefore permanently disposed at the IDA without any treatment. The ILF trenches were covered with approximately 73,000 yd^3 of low-level contaminated soils from OU1 sites to provide an appropriate grade as a base for the RCRA synthetic cover (Tetra Tech, 2008b). The CEA received approximately 49,000 yd^3 of low-level contaminated soils from OU1 sites (Tetra Tech, 2008b). The Trench 6 Landfill received approximately 74,000 yd^3 of moderately contaminated soils from OU1 sites (Tetra Tech, 2008b). Trench 7 received approximately 15,000 yd^3 of highly contaminated soils from OU1 sites (Tetra Tech, 2008b).

Conceptual Site Model

The IDA has received residential and industrial wastes (ILF Trenches 1-5 and Trench 6 North) including some RCRA hazardous wastes in a portion of Trench 5 and contaminated soils (Trench 6 Landfill, Trench 7, and the CEA) from soil remedial actions at various OU1 sites. A preliminary site characterization and site inspection (SI) (1991) and an RI (1993) have been conducted at the IDA in accordance with CERCLA requirements, including collection of soil, groundwater, surface water, and sediment samples. Given that the ILF trenches (including the Ash Disposal Cell previously closed with RCRA Subtitle C cover) have been closed with a synthetic liner cover system and Trench 6 and the CEA have been closed with RCRA Subtitle C synthetic liner cover systems, the current Industrial Land Use will remain the same in the future. Land use controls (LUCs) and post-closure monitoring will continue at the IDA in accordance with CERCLA and RCRA requirements.

The CSM presented in this section is based on the current understanding of the environmental conditions and the RCRA/CERCLA regulatory program applicable to the IDA. This section is organized as follows:

- Environmental Site Setting
  - Topography and Surface Drainage Features
  - Land Use
  - Geology and Hydrogeology
- Previous Investigations
- Previous Remedial Actions
- Long Term Monitoring and Management Program
- Current Nature and Extent Understanding
  - Potential Sources of Contamination
  - Hydrogeologic Conditions at the IDA
  - Soil
  - Sediment

- Surface Water
- Groundwater
    - Summary of Historical Data from Former Monitoring Wells Around ILF Trenches 1-5
    - Summary of Historical Data from Existing Monitoring Wells at the IDA
    - Summary of Historical Bis(2-ethylhexyl)phthalate (BEHP) Groundwater Data at the IDA
- Summary and Data Gaps

Environmental Site Setting

The following sections describe the physical site-specific characteristics and those that differ from the installation environmental setting presented in IAAAP Worksheet #10. In addition, a summary of the previous environmental investigations is provided.

Topography and Surface Drainage Features

The topography of the IDA has been significantly altered by the construction of the landfill and subsequent capping. The IDA is generally highest in the northwest area of the ILF and slopes in all directions. Based on the topography in the vicinity of the IDA, the original land surface was likely relatively flat-lying to southwest sloping.

Prior to the capping of the ILF Trenches 1-5 in 1998, surface drainage for the bulk of the ILF and the Former Burning Ground was directed into an intermittent stream on the south side of the ILF that flowed southwesterly from the area between Trenches 3 and 4, between wells JAW-66 and JAW-67, before turning south immediately south of Trench 6. At the time, drainage from the western side of the ILF was directed into the open Trench 6, which discharged to the same intermittent stream. The Blue Sludge Lagoon, Sludge Drying Bed, and western portion of the storage yard drained to an intermittent stream southwest of these areas. These intermittent streams ultimately discharge into an intermittent tributary of Long Creek.

Three sedimentation control structures were built during the mid-1990s as part of the remediation activities, which created sedimentation ponds downgradient of the CEA, Trench 6, and Trench 7. After the installation of the ILF, Trench 6, and CEA caps, the intermittent stream on the south side of the ILF was removed/filled and surface drainage at the IDA was controlled around the caps by man-made ditches. The sedimentation ponds were removed and revegetated in 2011 and 2012 and their use has been discontinued (Tetra Tech, 2013).

Surface water runoff from the IDA flows to the southwest toward an intermittent tributary of Long Creek, which is approximately 1,000 feet west of the IDA. The tributary then enters Long Creek approximately 4,000 feet south of the IDA. Long Creek eventually enters the Skunk River, which meets the Mississippi River 7 miles from the IDA.

Land Use

Land use at IAAAP is either agricultural, forested, administrative, or industrial as described in IAAAP Worksheet #10. Current land and future land use at the IDA is considered industrial. The site is located in a restricted, fenced-in boundary because of historical landfill operation and the site is closed to any residential or recreational use. LUCs are being implemented by the Army in accordance with requirements of a LUC Implementation Plan for the IDA.

Geology and Hydrogeology

The subsurface at the IDA is characterized by fill material, waste, and glacial till. The fill, generally consisting of silty clay, is a combination of impermeable cap and contouring layers that overlie ILF Trenches 1-5, Trench 6, and the CEA. The till underlies and surrounds the fill/waste and consists primarily of silty clay and clay with occasional discontinuous silty sand and sandy silt layers. The unconsolidated units are underlain by bedrock (interbedded shaly dolomitic limestone), which was encountered at depths ranging from 76 to 138 feet bgs (Tetra Tech, 2012). Twenty-three (23) groundwater monitoring wells are currently present at the IDA (Figure IDA-10-2): 17 wells are screened in the overburden (glacial till or glacial outwash) at depths ranging from 16 to 62 feet bgs; 1 well is screened across the overburden/bedrock interface to a depth of 116 feet bgs; and 5 wells are screened in bedrock underlying the till at depths ranging from 112 to 155.5 feet bgs. During closure activities at the IDA, 12 monitoring wells within the footprint of the IDA were also abandoned (Figure IDA-10-2). Cross-sections depicting the general lithology are presented in Figures IDA-10-3 and IDA-10-4. Shallow groundwater occurs at depths ranging from approximately 5 to 35 feet bgs in the “drift” aquifer and shallow groundwater flow generally mimics surface topography. Based on saturated thicknesses observed in monitoring wells in the “drift” aquifer, thickness of the overburden unit groundwater ranges from 10 to 30 feet thick. The low permeability of the clay till matrix limits lateral and vertical flow of groundwater. However, lateral and vertical flow can be locally increased in the tills above the bedrock where fracture networks or sandy/silty lithologies are well developed. The occurrence of these higher hydraulic conductivity zones is unknown, but believed to be related to relict glacial depositional features. Deep groundwater occurs at depths ranging from approximately 36 to 59 feet bgs in the “bedrock” aquifer, reflecting semi-confined conditions in some areas. An overall downward vertical gradient is indicated by groundwater elevations in the shallow overburden and bedrock monitoring wells at the IDA (Tetra Tech, 2012).

Hydrogeologic conditions at the IDA indicate significantly low hydraulic conductivities (e.g., horizontal conductivity of 5.5E-05 centimeters per second [cm/sec] and vertical conductivity of 2.8E-09 cm/sec) in the glacial till, resulting in very slow groundwater movement (8 to 26 feet/year) in the shallow “drift” aquifer and a low potential for contaminant migration to the deeper “bedrock” aquifer. Hydraulic conductivities in the shallow “drift” groundwater unit range from a minimum of 0.051 feet/day in well T-03 to a maximum of 1.96 feet/day in well T-05, with higher conductivities in the bedrock groundwater unit (0.15 feet/day in well T-07 to 51.02 feet/day in well T-06). Groundwater gradients measured between 1999 and 2016 at the IDA indicate low gradients in the shallow “drift” aquifer with a similar gradient range from year to year (0.017 [2001] to 0.060 feet/feet [2000]), while gradients in the bedrock groundwater unit are more variable (from 0.0028 [2004] to 0.037 feet/feet [2001]). Shallow groundwater flow is consistently to the southwest, while bedrock groundwater flow is generally to the south (Figures IDA-10-5 and IDA-10-6, respectively). Estimated effective porosity for the till is assumed to be in the range of 0.06 to 0.12 based on historical geotechnical data that indicates moisture content values between 12 to 17 percent for the till material. Using a historical geometric mean hydraulic conductivity of 0.147 feet/day, groundwater velocities are estimated to range from 8 to 26 feet/year in the glacial till of the “drift” aquifer. Estimated effective porosity for the bedrock is assumed to be in the range of 0.2 to 0.25. Using a historical geometric mean hydraulic conductivity of 1.19 feet/day (based on data for wells T-06, T-07, and T-09), groundwater velocities in the bedrock are estimated to range from 8 to 80 feet/year.

Previous Investigations

The previous investigations at the IDA are summarized in Table IDA-10-1 and discussed below.

During operation of the IDA, groundwater quality was originally assessed in 1981 via installation of four shallow overburden monitoring wells (G-4, G-5, G-6, and G-7) around the IDA boundary (Figure IDA-10-2) as part of an investigation within Long Creek watershed. These wells were sampled for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), explosives, and metals; results indicated that the majority of the analyte concentrations were non-detect.

The sampling results were documented in the *Contamination Report for the Iowa Army Ammunition Plant* (ERG, 1982). The results indicated that the majority of the analyte concentrations were non-detect with a few analytes (1-Ethylehexylbenzene, Tetrahydrofuran, barium, copper, zinc nitrate, and sulfate) reported as detected. No National Interim Drinking Water Standards (in effect at that time) were exceeded (ERG, 1982; JAYCOR, 1996). All of the detection limits reported did not exceed the screening level standards identified in Table 4-1 of ERG 1982; however, the detection limits were higher than those currently defined in the Installation-wide QAPP Appendix B.

In 1988, nine monitoring wells were installed at the IDA to monitor both the shallow “drift” or overburden aquifer and the deeper “bedrock” aquifer in the vicinity of Trench 5. Wells T-1, T-2, T-3, T-4, and T-5 were installed in the shallow “drift” aquifer to depths up to 41 feet bgs, and wells T-6, T-7, T-8, and T-9 were installed in the bedrock aquifer to depths of up to 140 feet bgs (Terracon, 1989). Wells T-2, T-3, and T-7 were located at the edges of the RCRA Ash Disposal Cell, and the remaining wells were installed to provide adequate coverage in the upgradient, downgradient, and crossgradient locations around Trench 5 and the RCRA Ash Disposal Cell. Groundwater samples were analyzed for VOCs, SVOCs, polycyclic aromatic hydrocarbons (PAHs), pesticides, PCBs, explosives, and metals. The sampling results were documented in the *Accelerated Groundwater Quality Assessment for the Ash Disposal Cell in Trench 5 and Line 6* (Terracon, 1989). Contaminant concentrations were non-detect or less than screening levels for most analytes. Screening level exceedances were observed for arsenic at wells T-6 and T-7, BEHP at wells T-1, T-3, and T6, and methylene chloride at wells T-1 and T-3.

During the SI field work conducted in 1991, soil, sediment, and surface water samples were collected in order to identify contamination that could have resulted from past activities at the ILF, the Former Blue Sludge Lagoon, the Former Burning Ground, and the Former Metal Storage Yard. The sampling results were documented in the *Preliminary Site Characterization Report for the Inert Disposal Area* (JAYCOR, 1993). The SI generally concluded that explosives in soils did not appear to be potential COCs for the site; however, several metals (arsenic, cadmium, chromium, copper, lead, and zinc) were observed in concentrations greater than background levels in surface soils at the IDA (JAYCOR, 1996). Groundwater samples were not collected during the SI field work in 1991.

From 1992 through 1993, RI field work was conducted at the site in a two-phased effort. The Phase I effort was designed to characterize the lateral and vertical extent of contamination in soil, determine the extent of migration of contaminants in groundwater, and assess whether runoff or leachate from the IDA was impacting the tributary of Long Creek approximately 1,000 feet west of the IDA. Soil screening samples were collected from the Former Burning Ground for explosives (40 samples) and metals (50 samples) analysis. Two (2) of the explosives screening samples and 15 of the metals screening samples were sent to a fixed laboratory for confirmatory analysis. Surface water and sediment samples were collected from the Long Creek tributary at upgradient and downgradient locations from the IDA and analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, and metals. The sampling results were documented in the *Revised Draft Final Remedial Investigation Report* (JAYCOR, 1996). Similar to the soil investigation results, only metals were detected in surface water and sediment samples, and explosives were not considered as COCs for surface water or sediment (JAYCOR, 1996).

In April 1993, five shallow wells in the “drift” aquifer (JAW-26, JAW-28, JAW-65, JAW-66, and JAW-67) and one deep well in the “bedrock” aquifer (JAW-27) were installed as part of the Phase II RI effort. Soil samples were collected from the six wells at the soil/groundwater interface and analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, and metals. JAW-26 was located southeast of Trench 1. JAW-65 was located south of Trench 1. JAW-66 was located in the southern portion of Trench 3. JAW-67 was located between the southern portions of Trench 3 and Trench 4. JAW-28 was located on the west side of the southern portion of Trench 6 Landfill. Wells G-4, G-5, and G-7, located around the boundary of the IDA, were also sampled in 1993 and groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, and metals. In 1995, two surface soil samples were collected from the Former Burning Ground to determine if the area was contributing to the VOCs in the surface water samples collected in 1991. Three sludge samples were also collected from the Former Sludge Drying Bed and analyzed for Toxicity Characteristic Leaching Procedure metals, per USEPA Region 7 request. The sampling results were documented in the *Revised Draft Final Remedial Investigation Report* (JAYCOR, 1996).

In November 1993, an accelerated groundwater quality assessment was conducted to evaluate the effects of past hazardous waste management practices at the Ash Disposal Cell. As part of this assessment, three additional shallow overburden wells (ET-1, ET-2, and ET-3) were installed around the RCRA Subtitle C cap for the Ash Disposal Cell at the northern end of Trench 5 (Earth Tech, 1994). These wells were installed to provide better coverage in the downgradient direction from the Ash Disposal Cell (the existing wells T2, T3, T4, and T5 were all crossgradient from the Ash Disposal Cell). Five rounds of groundwater sampling were conducted in wells ET-1, ET-2, ET-3, G-4, T-1, T-2, and T-3 between December 1993 and April 1994. The sampling results were documented in the *Accelerated Groundwater Quality Assessment for the Ash Disposal Cell in Trench 5 and Line 6* (Earth Tech, 1994).

The removal action at the ILF (discussed below) required that most of the existing RCRA monitoring wells be removed (CDM, 1997). In 1996, shallow overburden wells T-2, T-3, ET-1, ET-2, JAW-66, and JAW-67 were abandoned (ECC, 2001). Prior to the 1998 closure of ILF Trenches 1-5, shallow overburden wells T-4 and T-5 were also abandoned. Bedrock wells T-7 and T-8 were abandoned in 1997, while bedrock well T-9 was abandoned in 2011 (Aerostar, 2015). Shallow overburden monitoring wells ET-3, T-1, JAW-26, and JAW-28 and bedrock monitoring wells T-6 and JAW-27 currently exist at the site and are sampled as part of the current LTM program at the IDA. Between September 1997 and April 2007, additional shallow overburden and bedrock monitoring wells were installed, as necessary, to provide adequate spatial coverage around the footprint of the closed areas at the IDA. Figure IDA-10-2 shows the former and existing monitoring wells at the IDA. Historical groundwater monitoring was conducted for a broad range of analytes (explosives, metals, VOCs, SVOCs, pesticides, herbicides, PCBs, and radiochemistry). The current monitoring well network includes a total of 23 monitoring wells (17 in the overburden [glacial till or glacial outwash] aquifer and 6 in the bedrock aquifer). Currently, 13 wells in the overburden aquifer and 2 wells in the bedrock aquifer are sampled annually. The remainder of the existing wells (i.e., 4 wells in the overburden aquifer and 4 in the bedrock aquifer) are not in the LTM program and are not being used/sampled. Additional information on the well network (well construction data) and the monitoring program (analytes, frequency) are provided in Table 2 of the *2017 Annual Groundwater Monitoring Report for the Ash Disposal Cell Within Trench 5, Inert Disposal Area* (Aerostar 2018). Table 14-1 in IDA Worksheet #14 also provides details regarding the existing wells at the IDA (i.e., type of well [shallow or bedrock aquifer], screened interval, and whether the well is included in the current LTM program).

Table **IDA-**10-1. Previous Investigations (Site IAAP-020/020G)
UFP-QAPP RI, IAAAP, Middletown, Iowa

Year of Study/ Source	1981 IAAAP Contamination Survey[a]	1988 Groundwater Quality Assessment[b]	1991 SI[c]	1993 -1995 RI[d]	1993 – 1994 Accelerated Groundwater Assessment[e]	1994 – 2017 RCRA/CERLCA Monitoring[f]
Media Sampled	Groundwater (GW)	GW	Soil/ Sediment (SED)/ Surface Water (SW)	Soil/GW/ SED/SW	GW	GW/SW
Surface Soil (< 1 ft bgs)			2 samples	22 samples[g]		
Near Surface Soil (1 – 3 ft bgs)			5 samples			
Subsurface Soil				6 samples		
Groundwater	4 samples	9 samples		14 samples	7 wells vicinity of Ash Disposal Cell, 5 rounds of sampling	Extensive sampling of network of 23 monitoring wells, 43 rounds of sampling[f]
Sediment			4 samples	7 samples		
Surface Water			4 samples	7 samples		Annual Sampling of CEA-POOL-UPSTR location since 2007

[a] ERG, 1982

[b] Terracon, 1989

[c] JAYCOR, 1993

[d] JAYCORE, 1996

[e] Earth Tech, 1994

[f] Monitoring wells at the IDA were installed at various periods between 1981 and 2007 and the analyte list sampled varied by well location and depth (shallow "drift" versus "bedrock" aquifers). The frequency of sampling was initiated on a quarterly basis in 1994 during the Accelerated Groundwater Assessment (Earth Tech, 1994), reduced to semi-annual basis over time, and currently is conducted on an annual basis (Aerostar, 2017).

[g] During the Phase I RI, 50 screening samples were collected for explosives and metals, out of which 17 samples were submitted for laboratory analysis.

See Acronyms and Abbreviations for abbreviations used in this table.

Previous Remedial Actions

In 1984, the sludge from the Former Blue Sludge Lagoon was excavated, removed, and placed in a nearby dewatering bed in preparation for casting the sludge into concrete blocks for disposal. The excavated area was backfilled and capped with clay soil, and vegetative cover was established. A Federal Facility Compliance Agreement between the USEPA and IAAAP in June 1987 established the sludge as nonhazardous (Terracon, 1989).

In 1989, the Ash Disposal Cell in the northern portion of Trench 5 was capped and closed in accordance with RCRA Subtitle C requirements as described in the *Closure and Post-Closure Plans for Trench 5 of the Inert Landfill* (USACE, 1988). The RCRA cap included a 42-inch compacted clay layer overlain by a 6-inch topsoil vegetative layer. A synthetic liner was considered as an element of the cover system but not included in the final cover design due to concerns that differential settlement in the cap could rupture the synthetic liner. In March 1994, the USEPA issued a RCRA CA/CO which required an accelerated groundwater assessment in the Trench 5 area (USEPA, 1994). The hazardous constituents detected in groundwater during the groundwater assessment were not those constituents expected to result from the hazardous wastes disposed in the Ash Disposal Cell (namely barium, cadmium, chromium, and lead). In its approval letter dated June 16, 1995, the USEPA stated that “It appears that the contamination may not be from the wastes disposed of at the RCRA portion of Trench 5” and notified the Army of a reduction in the monitoring frequency at Trench 5 from a quarterly basis to semiannual basis (USEPA, 1995).

Beginning in 1997, the Army implemented a non-time critical removal action (NTCRA) to begin consolidating contaminated soils, excavated from four sites at the IAAAP, to within the IDA, in accordance with the Action Memorandum for the Inert Landfill (CDM, 1997). As part of this removal, cleanup and closure activities were initiated at the IDA, including removal of the Former Blue Sludge Lagoon and Sludge Drying Bed/Holding Pond material and removal of contaminated soil at the Former Burning Ground. Prior to removal of soils from the IDA Metals Storage Yard and Burning Grounds, a pre-design investigation was conducted in 1998 and the results were presented in a Pre-Design Excavation Delineation Summary Report (USACE, 1998c). A synthetic liner and a leak detection system were installed in the Trench 6 Landfill and used for the disposal of medium-level contaminated soils (cumulative excess cancer risks less than 10^{-5} but greater than 10^{-6}) excavated as part of the OU1 CERCLA remediation at the IAAAP. A former soil borrow area, Trench 7, located adjacent to Trench 6, was similarly lined and equipped with leak detection capabilities. This lined borrow area, designated by the USEPA as a CAMU, was used for the stockpiling and treatment of high-level contaminated soils (cumulative excess cancer risks greater than 10^{-5}) that were excavated as part of the OU1 CERCLA remediation at the IAAAP. The baseline risk assessment presented in the 1996 IAAAP RI (JAYCOR, 1996) provided the basis for the response actions that determined what soils were to be excavated and either disposed in the Trench 6 Landfill or Trench 7 (the CAMU). The IAAAP remediation goals presented in the 1998 OU1 IROD (USACE, 1998a) and 1998 OU1 ROD (USACE, 1998b) were established at a target carcinogenic risk of 10^{-6}. Both the Trench 6 Landfill and Trench 7 were constructed to meet RCRA Subtitle C landfill requirements.

In 1998, Trenches 1 through 5 were designated the ILF and capped with a synthetic cover system, including the Ash Disposal Cell portion of Trench 5 pursuant to the Action Memorandum for the Inert Landfill (CDM, 1997). The presumptive remedy for the landfill site was containment, which involved capping the existing landfill with an impermeable cover (CDM, 1997). Closure was performed by covering the trenches/wastes with a synthetic style cover system, which includes layers of compacted clay, a low-density polyethylene geomembrane, a geocomposite drainage layer, compacted select fill (low-level contaminated soil [cumulative excess cancer risks less than 10^{-6}] from OU1 remedial actions), topsoil, and a vegetative cover. Trench 6 North was not capped in 1998 so that it could continue to be used as an access to the Trench 6 Landfill to the south, and as a staging area for other construction activities.

By the spring of 2009, all of the soil within Trench 7 had been treated via biological and alkaline hydrolysis; in the fall/winter of 2009, all of the treated soil had been transferred to the Trench 6 Landfill. The liner from Trench 7 was also removed and placed in the Trench 6 Landfill. Soil sample locations during the “clean closure” activities at Trench 7 are shown on Figure IDA-10-2. In 2011, closure of the Trench 6 Landfill and Trench 6 North was performed by covering the trench with a RCRA Subtitle C-style cap, which includes a contouring layer, a geosynthetic clay liner, a low-density polyethylene geomembrane, a geocomposite drainage layer, compacted select fill, topsoil, and a vegetative cover. Prior to construction of the cap, the soil placed in the Trench 6 Landfill was stabilized with Class C Fly Ash to form a stable base for cap construction (Tetra Tech, 2012).

In 2010 and 2011, closure of the CEA was performed by covering the trench with a RCRA Subtitle C-style cap, which includes a contouring layer, a geosynthetic clay liner, a low-density polyethylene geomembrane, a geocomposite drainage layer, compacted select fill, topsoil, and a vegetative cover.

By 2012, the sedimentation ponds associated with Trench 6, Trench 7, and the CEA were removed from service. These ponds were originally designed to accumulate surface runoff from the area of the landfill cells in the ponds such that some sediment has a chance to settle out of the water prior to discharge. However, the design of the ponds was never intended to provide comprehensive sediment capture prior to discharge. Each of the sedimentation ponds contained a cement standpipe connected to a culvert that extends beneath a downgradient earthen berm. During closure activities conducted in 2011 and 2012, the holding capacity of the sedimentation ponds was permanently reduced by drilling drainholes in the standpipes to allow minimal water accumulation and to allow establishment of a vegetative cover in the former ponds. Extensive sampling of the surface water and sediment was conducted during closure of the sedimentation ponds for Trench 6, Trench 7, and the CEA. The sediments in the CEA Pond were sampled in November 2009, and the sediments in the Trench 7 and Trench 6 Sedimentation Ponds were sampled in July 2011 and August 2011, respectively. Sediment sample results from the CEA, Trench 6, and Trench 7 Sedimentation Ponds were compared to the remedial goals (RGs) established for OU1 soil (Tetra Tech, 2012). Analytical results did not exceed the OU1 RGs established for human health and leaching to groundwater. During closure of the sedimentation ponds, sediment sample results were used to conduct an ecological risk assessment for those areas using the same Food Chain Models (FCM) used in the OU1 ecological risk assessment. The ecological risk assessment for the sedimentation ponds concluded that there was no unacceptable risk posed to the Indiana Bat. (Tetra Tech, 2013).

An ecological risk assessment was included in the OU1 Phase 5, 7, and 8 Sites and Installation Wide Ecological RACR following completion of the OU-1 ROD and associated Explanation of Significant Differences (ESD). The risk assessment concluded that no unacceptable ecological risk was posed to the endangered Indiana Bat from exposure to contaminated soil within OU1. Any soil that required remediation was excavated and disposed at the IDA and there is no ecological exposure to the Indiana Bat in areas covered by the RCRA caps.

Long Term Monitoring and Management Program

From 1994 through 2017, 43 groundwater monitoring events have been completed at the IDA in accordance with the March 1994 RCRA CA/CO issued by the USEPA and pursuant to the IDA 1988 closure and post-closure monitoring plan (USACE, 1988), 1997 Amendment to the Closure/Post-Closure Plan (M&HC, 1997), and updated annual sampling and analysis plans. The first 10 events were performed quarterly; 22 subsequent events were performed semiannually, and events 33 through 43 were conducted on an annual basis. In 2007 prior to conducting sampling event 33, a comprehensive review of historical groundwater data was conducted by the Army Environmental Command (AEC), Tetra Tech, and the EPA and recommendations were submitted to the EPA to optimize the LTM program. The EPA formally documented the optimization changes to the monitoring program via its letter to the IAAAP Commander dated March 22, 2007 to IAAAP (USEPA, 2007). The existing monitoring well network includes a total of 23 monitoring wells (17 wells in the shallow “drift” aquifer and 6 wells in the bedrock aquifer). Currently, 13 wells in the shallow “drift” aquifer and 2 wells in the bedrock aquifer are sampled annually. The remainder of the existing wells (i.e., 4 wells in the shallow aquifer and 4 in the bedrock aquifer are not in the LTM program and are not being used/sampled. As part of the annual sampling, surface water samples are also collected at one location (CEA-POOL-UPSTR). Following a review of the historical groundwater data and EPA approval in 2007, surface water sampling at the CEA-POOL-UPSTR location was initiated in 2008 and the sample was collected on the upstream side of the former CEA Sedimentation Pond in lieu of installing an additional well downgradient of JAW-27. (Tetra Tech, 2008a). Sample results from CEA-POOL-UPSTR are included in the Annual Groundwater Monitoring Report, Ash Disposal Cell Within Trench 5, Inert Disposal Area.

In accordance with the 2008 OU4 IROD for Trench 6, Trench 7, and the Cap Extension Area of the IDA, groundwater monitoring is required to evaluate the performance of the landfill cover systems at Trench 6 and the CEA. Routine cover inspection, repairs, and maintenance are required for the CEA cap. Routine cover inspection, repairs, and maintenance are required for the Trench 6 cap, along with monitoring of the leachate collection and leak detection system. To address the groundwater monitoring requirement, a subset of the wells sampled under the RCRA LTM program are used to address the CERCLA requirements and reported in the Annual Groundwater Monitoring Report, Ash Disposal Cell Within Trench 5, Inert Disposal Area.

The shallow overburden wells in the LTM sampling program are sampled for explosives, metals, VOCs, SVOCs, total organic carbon (TOC), total organic halogens (TOX), radionuclides, gross alpha/beta activity, and field parameters (oxidation-reduction potential, dissolved oxygen, ferrous iron, pH, temperature, specific conductivity, and turbidity). TOX and TOC are used as indicator parameters for groundwater contamination pursuant to 40 CFR § 265.92(b)(3) requirements. Monitored Natural Attenuation (MNA) parameters (nitrate, nitrite, sulfate [SW846 Method 9056] and methane, ethane, ethene [RSK-175]) are also collected at shallow overburden wells (ET-3 and C-00-1) that have exhibited a consistent presence of contaminants. The bedrock wells are sampled only for TOC, TOX, and field parameters based on the lines of evidence from historical sampling results. The current LTM sampling program includes the requirements for RCRA post-closure care and also the CERCLA groundwater monitoring requirements in accordance with the OU4 IROD. The results are currently reported in the Annual Groundwater Monitoring Report, Ash Disposal Cell Within Trench 5, Inert Disposal Area.

Current Nature and Extent Understanding

This section presents a summary of potential sources of contaminants at the IDA and current site media.

Potential Sources of Contamination

Various historical documents identified locations within the IDA where contaminants may have been released into the environment (Table IDA-10-2). Results of the numerous investigations at the IDA indicate that explosives, metals, uranium, VOCs, SVOCs, and radionuclides are the contaminants detected in soil and groundwater that were generated by IAAAP site operations.

Table **IDA-**10-2. Potential Sources of Contaminants (Site IAAP-020/020G)
UFP-QAPP RI, IAAAP, Middletown, Iowa

Location or Location Type	Potential Source	Site ID	Rationale
Disposal Areas			
	Inert Disposal Area	IAAP-020	• Closed inert landfill with waste Trenches 1-5 and Trench 6 North; other areas at the IDA, such as Former Blue Sludge Lagoon, Former Sludge Drying Beds, and Former Metal Storage Yard; contaminated soils in Trench 6 Landfill and CEA.
Disposal Areas			
	Inert Landfill		• Operated 1941 – 1980s, RCRA closure in 1989. • Sanitary waste in Trenches 1-5. • Ash disposal of RCRA hazardous waste in northern portion of Trench 5; 1980 – 1983.
	Former Blue Sludge Lagoon		• Operated 1977 – 1981. • Former surface impoundment, 120 feet long by 30 feet wide with a sludge depth of 30 inches. • In 1984, the Blue Sludge Lagoon was excavated, backfilled, capped and a vegetative cover established. The excavated material was placed on the Sludge Drying Bed. • Deactivated sludge was established as non-hazardous (CDM, 1997). • Area located under CEA.
	Former Burning Ground		• Prior to 1982, salvageable metal was flashed in the open burning area. • Prior to late 1940s, used to burn debris from boxcars and to burn boxcars themselves. • In 1997, soil and debris was excavated and placed in Trench 6 or placed under the cap at the ILF (Tetra Tech, 2011a). • Area located under the ILF cap and the CEA.
	Former Sludge Drying Beds/ Holding Pond		• Dewatering bed for excavated sludge from Former Blue Sludge Lagoon. • In 1997, the “blue sludge” material was excavated and placed in Trench 6 (Tetra Tech, 2011a). • Area located under CEA.
	Former Metal Storage Yard		• Storage yard for recyclable items and scrap metal. • Area overlaps with CEA.

See Acronyms and Abbreviations for abbreviations used in this table.

Hydrogeologic Conditions at the IDA

In the vicinity of the IDA, the glacial till is subdivided into the facies (different stratigraphic units). The upper unit (superglacial facies) is composed of till interbedded with sorted and stratified sediments. The underlying unit (subglacial facies) is comprised of a clay-rich, firm, dense and overconsolidated till. Physical analysis of Shelby tube soil samples indicated vertical hydraulic conductivity values of 5.5E-05 and 2.6E-09 cm/sec from ET-1 (19.5 to 21 feet bgs) and JAW-26 (20 to 22 feet BGS), respectively, in the superglacial facies and 2.8E-09 and 1.7E-09 cm/sec in the subglacial facies from ET-1 (29.5 to 32 feet bgs) and ET-2

(29.5 to 31 feet bgs), respectively, of the till that comprises the shallow "drift" aquifer. Insitu hydraulic conductivity values were calculated from historical slug tests conducted at 1 well (G-7) in 1981 by ERG, and 9 wells (T series) in 1988 by Terracon and the results are presented in Table IDA-10-3. The hydraulic head relationships between the wells in the shallow overburden and bedrock aquifers indicate that the bedrock aquifer is in semi-confining or confining conditions. The difference in groundwater elevations between shallow overburden and bedrock wells can be as much as 40 feet at the IDA (Aerostar, 2015), indicating the two separate hydrogeologic regimes.

Table IDA-10-3. Summary of Historical Hydraulic Conductivity Values at the **IDA (Site IAAP-020/020G)**
UFP-QAPP RI, IAAAP, Middletown, Iowa

		Hydraulic Conductivity		Lithology		
Well	**Source**	**cm/sec**	**ft/day**	**Unit**	**Unified Soil Classification System (USCS) or Type**	**GW Unit**
T-03	Terracon, 1989	1.80E-05	0.051	Till, superglacial	CL	Shallow
T-01	Terracon, 1989	5.20E-05	0.15	Till, superglacial	CL	Shallow
T-04	Terracon, 1989	7.70E-05	0.22	Till, superglacial	CL	Shallow
G-7	ERG, 1982	9.95E-05	0.28	Till, subglacial	CL-ML	Shallow
T-02	Terracon, 1989	3.10E-04	0.88	Till, superglacial	CL	Shallow
T-05	Terracon, 1989	6.90E-04	1.96	Till, superglacial	CL	Shallow
T-07	Terracon, 1989	5.30E-05	0.15	Bedrock	Limestone to shale to dolomite	Deep
T-09	Terracon, 1989	1.90E-05	0.22	Bedrock	Limestone to shaly dolomite	Deep
T-06	Terracon, 1989	1.80E-02	51.02	Bedrock	Limestone with occasional chert and dolomite	Deep

CL = Clay, Low Plasticity (or Lean Clay), ML = Silt, CL-ML = Lean Clay-Silt
See Acronyms and Abbreviations for abbreviations used in this table.

Historically, the majority of the monitoring wells (a total of 19) in the glacial till have been less than 35 feet bgs and monitoring the superglacial facies, whereas there have been nine monitoring wells installed deeper than 35 feet bgs, which were most likely monitoring the deeper subglacial facies till above the bedrock. The median insitu hydraulic conductivity in wells T-1 through T-5 was 5.2E-05 cm/sec (0.15 feet/day), which are located in the superglacial facies, and in well G-7 was 9.95E-05 cm/sec (0.28 ft/day), which was located in the subglacial facies. While the hydraulic conductivity values for bedrock wells T-07 and T-09 were similar to those measured in the shallow "drift aquifer" wells, the hydraulic conductivity measured at bedrock well T-06 was significantly higher. This is attributable to the heterogeneous nature of the bedrock and the likely presence of fracture(s) that may cause preferential pathways for groundwater flow.

Soil

Soil samples at the IDA were historically analyzed for a broad suite of parameters to include explosives, metals, pesticides, PCBs, VOCs, and SVOCs. Removal actions were conducted in 1997 in accordance with the *Action Memorandum for the Inert Landfill* (CDM, 1997) at the Former Sludge Drying Bed/Holding Pond and Former Burning Ground to address soil contamination exceeding applicable criteria (USEPA Region III Risk-Based Concentrations [RBCs]) in effect at that time. As presented in Table IDA-10-2 earlier, excavated materials from the Former Sludge Drying Bed/Holding Pond (that stored contents from the 1984 excavation of the Former Blue Sludge Lagoon) and Former Burning Ground were disposed in Trench 6 or used for base grade under the cap at the ILF (ECC, 2001). These areas are now covered by the RCRA caps associated with ILF Trenches 1-5, and the CEA (Figure IDA-10-1).

Soil samples at the Former Burning Ground area, Former Blue Sludge Lagoon, Former Sludge Drying Bed/Holding Pond, and the Former Metal Storage Yard were collected in 1991 to 1998 primarily at depths ranging from 0.5 feet to 1.5 feet bgs. The only exceptions were two locations at the Former Blue Sludge Lagoon (20SA0101 and 20SA0201) where samples were collected at 3.0 feet bgs. Based on a review of the 2007 OU4 IROD (Tetra Tech, 2008b) and the 2010 As-Built Final Cover Plan for the CEA (Tetra Tech, 2012), a majority of the historical soil sampling locations were either excavated (ECC, 2001), are currently located under the RCRA caps, or were disturbed by the landfill cap construction activities. For 14 historical locations that are currently not under the RCRA caps (i.e., R14SA1401, R14SS1501, R14SA2701, R14SS604, 20SA0201, 20SS0401, 20SA0801, MSY-01, MSY-02, MSY-15, MSY-16, MSY-17, MSY-18, and MSY-19) as shown in Figure IDA-10-2), sampling results were compared to the soil screening values. The screening values presented in the Installation-wide QAPP Appendix B are either the installation-wide background values developed in the 2004 Baseline Ecological Risk Assessment (BERA) (average concentration plus two standard deviations) (MWH, 2004) or the most current USEPA residential and industrial regional screening levels (RSLs). Out of the above-referenced 14 locations, only 3 surface soil sample locations (i.e., R14SA1401, R14SA2701, and 20SA0801) exhibited metals exceedances (arsenic, chromium, lead, and thallium) above the background values (Installation-wide QAPP Appendix B). However, these 3 locations (R14SA1401, R14SA2701, and 20SA0801) are within the disturbed and regraded area of the engineered ditch constructed during the ILF and CEA capping activities (Tetra Tech, 2012). During construction of the engineered ditches, the disturbed areas were likely covered with clean soil during regrading and contouring operations. Consequently, it is reasonable to expect that the exposure pathway for a maintenance worker via ingestion or dermal contact is eliminated. The potential exposure to surface and subsurface soil is further mitigated with the use of LUCs at the IDA (e.g., preventing intrusive activity into or near the cap/cover system and maintaining the integrity of the cap/cover system).

The Army has researched extensively to track down the historical site records including maps and any construction completion reports that contain information regarding the disturbed areas. The Army has not been able to locate the missing information as yet. If the Army is unsuccessful in obtaining the historical records, confirmation soil sampling will be conducted in the future at and around the 3 sampling locations (R14SA1401, R14SA2701, and 20SA0801) from 1991-1992 that exhibited metals exceedances above current background concentrations.

In summary, given that the historical locations that exhibited contaminant concentration exceedances above the applicable RSLs were either (a) excavated and placed under existing RCRA caps, (b) disturbed and regraded during the construction of the ILF and CEA RCRA caps, or (c) disturbed and regraded within the engineered ditch constructed during the ILF and CEA landfill capping activities, potential exposure to surface and subsurface soil at the IDA is not a complete exposure pathway for human or ecological receptors and additional soil sampling at the IDA is not necessary.

Sediment

The surface drainage features located within the IDA boundary fence where sediment samples were collected during the 1991 and 1992 SI and RI field activities have been significantly altered by the construction of the landfill and subsequent capping during the remediation activities of the late 1990s and 2000s. Several of the sediment sampling locations within the drainages no longer exist following the remedial activities at the IDA. However, the historical sediment sampling results from locations not underneath a cap or potentially disturbed by landfill construction activities (i.e., 20SD0301, 20SD1101, R14SD0101, and R14SD0401) were compared to the soil screening values for installation-wide background values developed in the 2004 BERA (average concentration plus two standard deviations) (MWH, 2004) or the most current (2017) USEPA industrial RSLs (Installation-wide QAPP Appendix B). As part of the evaluation for this QAPP, the sediment data was considered dry sediment due to proximity of the sample locations within historical drainage features within the IDA. These locations were within the current fenced boundary of the IDA and the historical drainage features that existed during the 1991 and 1992 SI and RI field activities no longer exist following the remedial activities at the IDA. For the sample locations that potentially, remain, the site characterization results indicated several metals (cadmium, chromium, mercury, selenium, and silver) exceeded the screening levels (site background values). While the metal concentrations exceed background concentrations at all locations, there is a single exceedance of chromium at 20SD0301 above the EPA residential soil RSL. All other metal concentrations are below the EPA residential soil RSLs. Thus, the metal concentrations at locations R14SD0101, R14SD0401, and 20SD1101 are protective of any potential human health exposure to site workers. Sample location 20SD0301 is located in a wooded area where access is unlikely by site workers during routine landfill maintenance activities. Also, note that the chromium concentration at 20SD0301 (36.8 milligrams per kilogram [mg/kg]) only slightly exceeds the chromium site background concentration (35.23 mg/kg). Overall, the metal concentrations at the four sample locations in question don't pose unacceptable risk to current or potential future workers. Additionally, one VOC and three PAHs were detected, but below EPA residential and industrial soil RSLs and ecological screening criteria. No SVOCs, explosives, pesticides, or PCBs were detected.

During the closure of the CEA Sediment Pond in 2009 and Trench 6 and Trench 7 Sedimentation Ponds in 2010, chromium was the only constituent with slight exceedances (50.2 mg/kg and 37.2 mg/kg) above the background value (35.23 mg/kg) at two locations in Sedimentation Pond 6. Sedimentation Ponds 6 and 7 are located outside the IDA fence boundary and the CEA Sedimentation Pond is located inside the IDA fence boundary that was installed in 2016. While the chromium concentrations slightly exceeded the background value at two locations at Sedimentation Pond 6, the chromium concentrations were significantly below the OU1 soil remedial goal of 10,000 mg/kg for chromium that was based on human health risk and leaching to groundwater. Because LUCs are in place at the IDA in accordance with the September 2008 Interim Action ROD for OU4 (Tetra Tech 2008b), potential exposure to sediment at the IDA is not a complete exposure pathways for human receptors. As discussed in the CEM that follows, there are potentially complete exposure pathways for ecological receptors that contact sediment at the former sedimentation ponds.

The LUCs at the IDA include access and use restrictions, specifically to "prevent intrusive activity into or near the cap system; maintain the cover/cap system; and to restrict property access to only authorized individuals for approved O&M purposes through the use of the security and safety measures at the IAAAP." Additionally, an IDA boundary fence further restricts access. While the LUCs are not intended to directly protect ecological receptors, maintenance of the cover/cap system, IDA boundary fencing, and routine inspections reduce the likelihood that ecological receptors would utilize the limited habitat at the IDA. The Army is responsible for maintaining, monitoring, enforcing, and reporting on the effectiveness of institutional controls at the IDA. There have been 2 five-year review documents published in 2011 and 2016 that evaluated the effectiveness of controls at the IDA. The protectiveness statement from both the 2011 and 2016 Five Year Reviews conclude that the remedy at OU4 is currently protective of human health and the environment.

Surface Water

The historical surface water sampling results were compared to the surface water project action limit (Installation-wide QAPP Appendix B) based on ecological and human health criteria (IAAAP Worksheet #15). A 1991 sample (20SW1001) had a detection of chromium and lead in excess of the current project action limit. This former sample location was located in the former drainage pathways downgradient of an area that has been capped and is located within the fenced boundary area of the IDA. At surface water sampling location CEA-POOL-UPSTR, vinyl chloride (VC) has been consistently non-detect at the 1 microgram per liter (μg/L) detection limit since 2012. Annual sampling of VOCs at this location was initiated in 2011. The most recent available annual sampling results for 2016 and 2017 indicate VC was non-detect at a detection limit of 1 μg/L. During the 2015 through 2017 sampling events at CEA-POOL-UPSTR, a few other VOCs (namely 1,1-dichloroethane [1,1-DCA], 1,2-DCA, and 1,1-dichloroethene [1,1-DCE]) were detected; however, all detections were below the applicable surface water project action limits (Installation-wide QAPP Appendix B). The results for the CEA-POOL-UPSTR sampling are provided in each of the 2007 to 2017 *Annual Groundwater Monitoring Reports for the Ash Disposal Cell Within Trench 5, Inert Disposal Area*.

Per the ongoing RCRA monitoring program for the IDA, annual sampling for VOCs has been conducted at the CEA-POOL-UPSTR sampling location, downgradient of the IDA and upstream of the former CEA sedimentation pond.

Groundwater

The groundwater contamination at the IDA is discussed in the context of historical and existing monitoring wells that were installed to investigate the shallow "drift" aquifer and the deeper "bedrock" aquifer. The following discussion provides lines of evidence to demonstrate that the groundwater contamination is primarily limited to the shallow "drift" aquifer, with limited vertical migration to the deeper "bedrock" aquifer.

The historical groundwater sampling analytical results (1988 through 2017) were compared to the June 2017 USEPA RSLs (i.e., the maximum contaminant levels [MCLs]; or the higher of the USEPA tap water RSLs or health advisory levels was used if no MCLs were applicable (Installation-wide QAPP Appendix B).

Figure IDA-10-7 presents a site map depicting the COC exceedances in groundwater at the IDA from the most recent sampling event for each well while Figure IDA-10-8 presents a site map depicting COC exceedances in groundwater based on the 2014 through 2017 sampling results.

Contaminant monitoring results were evaluated for the following various wells, over numerous sampling events, with the exceedances from the most recent sampling event presented in Figure IDA-10-7:

<u>Former monitoring wells within and around the footprint of ILF Trenches 1-5:</u>

- Shallow Overburden Wells
  - ET-1 and ET-2: 11 sampling events (1993 to 1996)
  - T-2, T-3, T-4, and T-5: 11 sampling events (1988, 1999 to 2005)
  - JAW-66 and JAW-67: 10 sampling events (1993 to 1996)
- Bedrock Wells
  - T-7 and T-8: 5 sampling events (1988, 1994 to 1995)
  - T-9: 8 sampling events (1988, 1994 to 1995, 1999 to 2000, 2005)

<u>Existing monitoring wells around the footprint of ILF Trenches 1-5, Trench 6, Trench 7, and CEA:</u>

- Shallow Overburden Wells
  - T-1: 42 sampling events (1988, 1993 to present)*
  - ET-3: 40 sampling events (1993 to present)*
  - G-4: 36 sampling events (1981, 1985, 1992 to 2006)
  - G-5: 43 sampling events (1981, 1985, 1992 to present)*
  - G-6: 15 sampling events (1981, 1985, 1992, 1994 to 2000)
  - G-6R: 24 events (2001 to present)*
  - G-7: 34 sampling events (full suite [9 events]: 1981, 1985, 1992 to 1995, 1999, 2000; TOC and TOX [25 events]: 1995 to present)*^
  - CAMU-99-1S, -2S, and -3S: 13 sampling events (1999 to 2005)
  - JAW-26 and JAW-65: 37 sampling events (1993 to present)*
  - JAW-28: 31 events (1993 to 2010)
  - C-00-1, C-00-2, and C-00-3: 25 events (2001 to present)*
  - C-95-1 and C-95-2: 30 events (1998 to present)*
  - IDA-TT-MW1: 11 events (2007 to present)*
- Bedrock Wells
  - CAMU-99-1D and CAMU-99-2D: 15 sampling events (1999 to 2006)
  - IDA-MW1 and IDA-MW2: 10 events (2000 to 2005)
  - T-6: 34 sampling events (full suite [7 events]: 1988, 1995, 1999, 2000, 2006; TOC and TOX [27 events]: 1995 to present)*^
  - JAW-27: 36 sampling events (full suite [7 events]: 1993 to 1995, 1999 to 2001; TOC and TOX [29 events]: 1995 to present)*^

( ) Exceedances from the most recent sampling event are shown in parenthesis.
* Wells are currently sampled as part of the LTM program.
^ While the deeper “bedrock” aquifer wells T-6 and JAW-27 are no longer sampled for the broader suite of analytes, these two wells have been sampled for TOC and TOX since 1995 under the RCRA monitoring or combined RCRA/CERCLA monitoring programs and reported in the Annual Groundwater Monitoring Report, Ash Disposal Cell Within Trench 5, Inert Disposal Area. Similarly, shallow “drift” aquifer well G-7 is also no longer sampled for the broader suite of analytes as historical data consistently exhibited non-detect concentrations. G-7 has also been sampled for TOC and TOX since 1995.

TOX and TOC are used as indicator parameters for groundwater contamination pursuant to 40 CFR § 265.92(b)(3) requirements. Concentrations of TOC and TOX measured during Rounds 41 (2015) and 42 (2016) were generally consistent with previous results and are documented in the Annual Groundwater Monitoring Reports for 2015 and 2016, respectively (Aerostar, 2015 and 2017). Using the Wilcoxon Signed-Rank Test (at a 95 percent confidence level) to evaluate the statistical difference between background concentrations and site concentrations, all TOX values for all sampling locations were not statistically higher than the TOX value at background well T-1 (Aerostar, 2017). The test results indicate that (at a 95 percent confidence level) TOC values were not significantly higher than background except for the JAW-27 and CEA-POOL-UPSTR sampling locations (Aerostar, 2015; Aerostar, 2017). The SRI report will include a more comprehensive discussion of the historical groundwater analytical results.

Sampling of the “bedrock” aquifer wells have been discontinued at different times as indicated above. Prior to the sampling Round 33 in 2007, a comprehensive review of historical groundwater data (including statistical analysis) and historical water levels revealed opportunities to optimize the groundwater monitoring program (for both the shallow and deep wells) while continuing to provide adequate monitoring of contaminant migration. The optimization evaluation was documented in the *Groundwater Monitoring Data Review Trench 5 Inert Disposal Area Iowa Army Ammunition Plant* (CCJM, 2007), which is located in Appendix J of the *2007 Annual Groundwater Monitoring Report, Ash Disposal Cell Within Trench 5, Inert Disposal Area* (Tetra Tech, 2007). All stakeholders, including the EPA, reviewed the historical groundwater data at that time. Optimization changes to the monitoring program were formalized via a letter from the EPA to the IAAAP Commander, dated March 22, 2007 (USEPA, 2007).

Summary of Historical Groundwater Data from Former Monitoring Wells around ILF Trenches 1-5

Based on groundwater monitoring events from 1988 to 1996, the former monitoring wells within the footprint of the capped ILF Trenches 1-5 consistently showed detection of metals and showed few, sporadic detections of VOCs, SVOCs, and explosives. As a snapshot of the groundwater in the vicinity of ILF Trenches 1-5, the May 1995 sampling results for former wells ET-1, ET-2, T-2, T-3, T-7, T-8, JAW-66, and JAW-67 and one existing well ET-3 are presented for select VOCs, SVOCs, explosives, and metals on Figure IDA-10-9. The May 1995 sampling event was selected for evaluation as a representative event during which all the wells within the IDA footprint were sampled prior to well abandonments in 1996 and 1997 and capping in 1998. As Figure IDA-10-9 illustrates, contamination was limited to the shallow “drift” aquifer at ET-1, ET-3, and JAW-67. At ET-1, the compound 1,1-Dichloroethane was detected above the RSL. At ET-3, the pentachlorophenol (PCP) concentration exceeded its MCL and 2,4,6-trinitrotoluene was detected above the RSL. At JAW-67, lead was detected above the MCL. No exceedances were observed in the former bedrock wells T-7 and T-8 around the RCRA Ash Disposal Cell.

Summary of Historical Groundwater Data from Existing Monitoring Wells at the IDA

Vicinity of ILF Trenches 1-5. As discussed previously, several of the wells within ILF Trenches 1-5 have been abandoned during closure activities, except shallow overburden monitoring well ET-3 located downgradient of the RCRA Ash Disposal Cell. ET-3 sampling results over a 24-year period between 1993 and 2017 are presented graphically for select constituents from the broad range of analytes sampled at the IDA. Figure IDA-10-10 presents the concentration trends for select SVOCs (PCP), VOCs (trichloroethene [TCE]), metals (arsenic), and explosives (royal demolition explosive [RDX]), respectively. PCP and arsenic concentrations were detected above the MCL at ET-3. The majority of the TCE and RDX concentrations at ET-3 were non-detect and have been plotted at the detection limits as reported in the historical results. The concentration trend graphs presented in Figure IDA-10-10 show that the contaminant concentrations detected in groundwater at ET-3 demonstrate a decreasing tend over more than 40 monitoring events since cap construction. However, the arsenic concentrations in ET-3 showed increasing concentrations since 1999 and then were detected above the MCL (10 µg/l) with the maximum concentration of 23.5 µg/l reported in the Fall of 2004. Since 2008, the concentrations have been fluctuating around the MCL (Figure IDA-10-10). An evaluation of PCP concentrations at ET-3 and the surrounding shallow overburden wells (ET-1, ET-2, T-2, and T-3) and bedrock wells (T-7, T-8, and T-9) was also conducted for the available data from 1993 to 1998 (i.e., prior to abandonment of these wells). Figure IDA-10-11 shows the consistent non-detect PCP trend for bedrock aquifer wells within the footprint of the IDA (T-7, T-8, and T-9) and the downgradient wells outside the IDA footprint (CAMU-99-1D and IDA-MW1). Note that the detection limits for historical PCP results were not sufficiently low to meet the current project screening levels. Nonetheless, the historical results indicate PCP concentrations observed in the shallow aquifer (ET-3) were orders-of-magnitude higher than the non-detect PCP concentrations (detection limits ranging from 0.69 µg/L to 51 µg/L) observed in the monitoring wells in deeper bedrock aquifer.

The boring log for ET-3 indicates waste materials typically disposed in Trench 5, including pieces of painted wood, were encountered at depths ranging from 4.5 feet to 19.5 feet. The most common use of PCP is as a wood preservative, and it is likely that the wood debris encountered at ET-3 may be the potential source of PCP contamination in groundwater (Earth Tech, 1994). Explosives-contaminated wood boxes and pallets were burned at the contaminated waste processor, one of the sources of ash disposed in the Ash Disposal Cell. Thus, the ash from the contaminated waste processor could also be the potential source of PCP. While ET-3 consistently showed high concentrations of PCP, all the other shallow overburden wells (ET-1, ET-2, T-2, and T-3) and bedrock wells (T-7, T-8, and T-9) exhibited non-detect concentrations of PCP, thereby suggesting that the extent of the PCP may be limited, both laterally and vertically within Trench 5. This same trend was also observed for TCE, arsenic, and RDX, as presented on Figure IDA-10-10. The Army acknowledges the concern with the detection limits for historical PCP results not being sufficiently low to meet the current project screening levels. However, as discussed above, the PCP concentrations observed in the shallow aquifer (ET-3) were orders-of-magnitude higher than the non-detect PCP concentrations (detection limits ranging from 0.69 μg/L to 51 μg/L); thereby suggesting that the extent of PCP may be limited in extent.

Radionuclides have also been detected sporadically in wells in and around ILF Trenches 1-5. In May 1995, the gross alpha/beta MCLs were exceeded in wells ET-3, and JAW-67; and gross alpha MCL was exceeded in wells JAW-66, T-1, T-2, and T-3. There was no exceedance of gross alpha/beta MCLs in subsequent sample events of these wells.

*Vicinity of CEA***.** Four overburden wells (C-95-1, JAW-65, JAW-26, and G-6R) have been sampled around the perimeter of the CEA between 1994 and 2017 as part of the LTM program. VOCs and SVOCs are only analyzed at well C-95-1 and no constituents have been detected. There have been isolated exceedances of metals above project screening levels (Installation-wide QAPP Appendix B), predominately occurring in 2011 or 2012. However, there have been no metals exceedances since 2013. RDX and high melting explosives (HMXs) have historically been detected in JAW-65 and C-95-1 as shown in Figure IDA-10-12 and fluctuated during the OU1 remedial activities. Since the CEA closure and capping in 2010, the concentrations have been decreasing and RDX has been below the health advisory level (HAL) of 2 μg/L since 2011 (Figure IDA-10-12). HMX concentrations have always been below the HAL of 400 μg/L. All gross alpha/beta detections have been less than the MCLs.

Southwest and Downgradient of CEA. Historically, the shallow overburden wells (C-00-1, C-00-2, C-95-2, IDA-TT-MW1, and G-7) at the IDA exhibited detections of a broader range of contaminants, to include VOCs, SVOCs, gross alpha/beta activity, radionuclides, explosives, and metals; however, a majority of these detections were below their applicable screening levels with the exception of chlorinated solvents in well C-00-1. The most recent available sampling results for May 2017 exhibit the similar trends with detections of TCE; 1,1-DCE; and 1,2-DCA at C-00-1 exceeding their respective MCLs. Sampling results for C-00-1 between 2001 and 2017 are presented graphically for select VOC constituents that have been detected consistently at C-00-1. The concentration trend graph (with straight line regression fit trend lines) in Figure IDA-10-13 indicates that the TCE; 1,1-DCE; and 1,2-DCA concentrations in groundwater at C-00-1 have demonstrated a very stable/declining trend over 25 monitoring events between 2001 and 2017.

An evaluation of TCE, 1,1-DCE, and 1,2-DCA concentrations at bedrock well JAW-27, located in the vicinity of C-00-1, was also conducted for the available data for four sampling events (1993, 1999, 2000, and 2001) before VOCs were eliminated from the sampling suite for JAW-27. Note that these analytes were not detected at JAW-27 during these four events (refer to Figure IDA-10-14), suggesting that the VOC contamination is limited to the shallow “drift” aquifer in the vicinity of C-00-1. Available sampling results were also evaluated for shallow overburden wells G-7 and C-00-2, which are located downgradient and crossgradient from C-00-1, respectively. The TCE, 1,1-DCE, and 1,2-DCA concentrations were non-detect at G-7 during 6 sampling events between 1985 and 2001 and non-detect at C-00-2 during 25 sampling events between 2001 and 2017 (Figure IDA-10-14). These results suggest that the extent of VOC contamination in the shallow "drift" aquifer is limited in extent around C-00-1.

TOC and TOX are measured annually at select site wells, including bedrock well JAW-27. TOC and TOX have been measured at well JAW-27 since 1995 over 29 sampling events. The recent results during Rounds 41 (Spring 2015) and 42 (Spring 2016) were generally consistent with previous historical results. Using the Wilcoxon Signed-Rank Test (at a 95 percent confidence level) to evaluate the statistical difference between background concentrations and site concentrations, all TOX values for all sampling locations including JAW-27 were not statistically higher than the TOX value at background well T-1 (Aerostar, 2015; Aerostar 2017). The 2015 and 2016 test results for JAW-27 indicate that (at a 95 percent confidence level) the TOC values were significantly higher than background (Aerostar, 2015; Aerostar, 2017); however, these values were consistent with historic TOC values reported for JAW-27.

*Vicinity of Trench 6***.** 43 sampling events have occurred between 1994 and 2017 from wells in the vicinity of Trench 6. Wells C-00-3 and G-5 are currently in the LTM program and located to the southwest. These wells have had sporadic detections of VOCs (acetone and toluene), SVOCs (1,2,4-trichlorobenzene; 4-chlroro-3-methyphenol; BEHP; caprolactam; and diethyl phthalate), explosives (2,3,6-trinitrotoluene; HMX; and RDX), radionuclides, and 23 inorganic compounds. There are no consistent trends with respect to the detections. All organic detections since 2002 have been less than MCLs or HALs. There have been isolated exceedances of MCLs or HALs for the metals, with no exceedances since 2007. All gross alpha/beta detections have been less than the MCLs.

Abandoned wells ET-1, ET-2, T-4, and T-5 were located on the east and west sides of Trench 6 and were removed from the monitoring program in 2005 or 2006, with the exception of ET-2, which was removed in 1995. ET-1 and ET-2 indicated the presence of BEHP, methylene chloride and gross alpha/beta above MCLs and ET-2 also showed lead above MCLs. BEHP was the only constituent to exceed a MCL in T-5 in one sample event and no constituents exceeded MCLs in T-4. In abandoned well JAW-28, located to the southwest mercury, chromium, and/or BEHP exceeded MCLs sporadically.

*Vicinity of Trench 7***.** Three overburden wells (CAMU-99-1S, CAMU-99-2S, and CAMU-99-3S) were sampled around the perimeter of Trench 7 between 1996 and 2005. These wells have had sporadic detections of VOCs (acetone, 1,1-DCA, cis-1,2-DCE, 1,2-DCE, and Freon 113), SVOCs [BEHP], radionuclides, explosives (2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, RDX), and 18 inorganic compounds. There are no consistent trends with respect to the detections. BEHP was the only organic compound to sporadically exceed its MCL. There were isolated exceedances of MCLs or HALs for the metals in 2004. All gross alpha/beta detections have been less than the MCLs.

"Bedrock" Aquifer. The historical data for the existing shallow overburden and bedrock monitoring wells around the perimeter of the IDA indicate a similar consistent contaminant trend as observed for the former wells within the IDA footprint (Aerostar, 2015). Comparison of contaminant concentrations at shallow/deep well pairs of ET-3/T-8 and C-00-1/JAW-27, discussed above, indicates that groundwater contamination is primarily limited to the shallow "drift" or overburden aquifer. Sampling results were evaluated for eight monitoring events each for the following bedrock wells: upgradient well T-6, downgradient well JAW-27, and crossgradient wells IDA-MW1 and IDA-MW2. Similarly, sampling results were also reviewed for 14 monitoring events each for crossgradient bedrock wells CAMU99-1D and CAMU99-2D. The results exhibited the presence of very few contaminants in the "bedrock" aquifer, with a few metals (arsenic, cadmium, chromium, and lead) and one SVOC [BEHP] the primary detected contaminants. Arsenic concentrations slightly exceeded MCLs in wells T-6 and JAW-27. Radionuclides have been detected sporadically in the bedrock aquifer. Gross alpha/beta MCLs were exceeded in

isolated sampling events in T-6 (May 1995) and there was no exceedance of gross alpha/beta MCLs in subsequent sample events of these wells.

Summary of Historical BEHP Groundwater Data at the IDA

Historically, BEHP has been detected in wells exceeding the MCL throughout the IDA between 1988 and 2004 in both the shallow "drift" aquifer (C-95-2, CAMU-99-2S, ET-1, ET-2, ET-3, G-4, G-5, IDA-MW1, JAW-26, JAW-28, JAW-65, JAW-67, T-1, T-2, T-3, T-4, T-5, T-9) and the "bedrock" aquifer (CAMU-99-2D, T-6, T-7, T-8). BEHP has only been detected in one well (C-00-3) at a concentration below the MCL between 2005 and 2017.It is unclear whether BEHP actually migrated from the landfill, as several of the wells in question were located upgradient of the landfill, or was there a sampling artifact due to the presence of plastics in the well material, cross contamination of sampling equipment, sampling materials, or laboratory equipment. Since BEHP has not been prevalent across the site in the last 12 years of sampling, it is presumed that the results from the 1990s and early 2000s were due to various sampling artifacts and not as a result of landfill contamination.

Summary and Data Gaps

In summary, the Army believes that the nature and extent of contamination at the IDA has been appropriately characterized, based on the following:

- Contaminated soil/material associated with the Former Burial Ground Area, Former Blue Sludge Lagoon, and Former Sludge Drying Bed/Holding Pond has been removed and extensive soil sampling was conducted to characterize soil contamination at the IDA prior to these removal actions. Any historical exceedance locations were either (a) excavated and placed under existing RCRA caps, (b) disturbed and regraded during the construction of the ILF and CEA RCRA caps, or (c) disturbed and regraded within the engineered ditch constructed during the ILF and CEA landfill capping activities. The potential exposure to surface and subsurface soil is further mitigated with the use of LUCs at the IDA (e.g., preventing intrusive activity into or near the cap/cover system and maintaining the integrity of the cap/cover system). Potential exposure to surface and subsurface soil at the IDA is not a complete exposure pathway for human or ecological receptors. The Army has researched extensively to track down the historical site records including maps and any construction completion reports that contain information regarding the disturbed areas. If the Army is unsuccessful in obtaining the historical records, confirmation soil sampling will be conducted in the future at and around the 3 sampling locations (R14SA1401, R14SA2701, and 20SA0801) from 1991-1992 that exhibited metal exceedances above current background concentrations.
- For sediment, the CEA, Trench 6, and Trench 7 Sediment Ponds have been closed and a vegetative cover has been established on the former ponds. Two of these former pond locations are also located within the area of the IDA boundary fence and are not accessible to unauthorized personnel. Historical surface drainage features located within the IDA boundary fence, where the majority of the dry sediment samples were collected in the early 1990s, have been significantly altered by the construction of the landfill and subsequent capping; thus, these drainage features no longer exist. Additionally, the sediment sample results did not exceed the OU1 remediation goals. These areas are currently covered by vegetation. There is no wet sediment present at the site; therefore, no additional investigation is warranted.
- The only "surface water" at the IDA is where groundwater discharges to the ephemeral ditch entering the north end of the CEA Pond. This location (CEA-POOL-UPSTR) provides downgradient discharge monitoring location for VOC plume monitored by well C-00-1 and is monitored under the ongoing RCRA/CERCLA LTM program for VOCs, TOC, and TOX. The LTM program will provide the necessary information for the RI; therefore, additional sampling at this location is not proposed

- Abandoned wells JAW-66, JAW-67, T-2, T-3, T-7, T-8, ET-1, ET-2 were monitored prior to the capping of the ILF Trenches 1-5, provided a sufficient well network, and indicated that groundwater contamination was limited, both spatially and temporally, to sporadic exceedances of select analytes as shown in Figure IDA-10-7.
- Existing wells JAW-26, JAW-65, T-1, T-6, G-4, G-5, IDA-TT-MW1, C-95-2 and C-95-1, which surround the perimeter of ILF Trenches 1-5, provide more recent groundwater data under the LTM program and indicate that concentration trends are stable and horizontal and vertical migration is limited. Groundwater sampling results for these wells have been mostly non-detect since 2010 with sporadic and limited detections below project screening levels. The exception was one cadmium detection (out of 44 data points) in G-4 at 7.6 µg/l as compared to the screening level of 5 µg/l.
- Existing overburden wells C-96-1, JAW-65, JAW-26, and G-6R that surround the perimeter of the CEA are sampled as part of the current LTM program and results indicate that (1) RDX and HMX concentrations have been decreasing since the construction of the CEA cap, (2) metal exceedances of MCLs or HALs are isolated, and (3) no VOCs or SVOCs have been detected.
- Existing overburden wells C-00-3 and G-5 that surround the perimeter of Trench 6 are sampled as part of the current LTM program and results indicate (1) sporadic detections of VOCs, SVOCs, and explosives with no consistent trend and the most recent detections are less than the MCLs or HALs and (2) metal exceedances of MCLs or HALs are isolated with no exceedances since 2007.
- Existing overburden wells CAMU-99-1S, CAMU-99-2S, and CAMU-99-3S that surround the perimeter of Trench 7 indicate (1) sporadic detections of VOCs, SVOCs, and explosives with no consistent trend and the most recent detections are less than the MCLs or HALs and (2) metal exceedances of MCLs or HALs are isolated with no exceedances since 2007.
- Two wells (C-00-1 and ET-3) at the IDA have consistently indicated concentrations above MCLs while groundwater contamination at the other IDA monitoring wells has been limited to sporadic exceedances, both temporally and spatially. The concentration of chlorinated solvents and PCP at C-001 and ET-3 have been stable for 10 to 15 years.
- Hydrogeologic conditions at the IDA indicate significantly low horizontal and vertical hydraulic conductivities (e.g., horizontal conductivity of 5.5E-05 cm/sec and vertical conductivity of 2.8E-09 cm/sec) in the glacial till, resulting in very slow lateral groundwater movement (8 to 26 feet/year) in the shallow “drift” aquifer and a low potential for contaminant migration to the deeper “bedrock” aquifer.
- A comprehensive review of historical groundwater data and optimization of the groundwater monitoring program was last conducted by the Army and EPA in 2007. It is recommended that a comprehensive round of groundwater samples be collected from all site wells (Figure IDA-10-15) to evaluate the current nature and extent of contamination in order to further optimize the groundwater monitoring program and to verify the previous decision(s) to stop sampling some wells completely and to sample other wells for only certain analytes are still valid. The Army acknowledges that detection limits for some of the historical data were not sufficiently low to meet the current project screening levels. The Army will ensure that appropriate laboratory reporting limits (lower than the project screening levels) are attained. The proposed sampling will provide a snapshot of current comprehensive COC data from the shallow and deep wells that will provide a clearer path forward for the placement of any potential new well(s).
    - Groundwater samples will be analyzed for VOCs, SVOCs, explosives, and metals (unfiltered samples) as these have been the broad range of contaminants historically detected above screening criteria in groundwater (Installation-wide QAPP Appendix B).

- MNA parameters (nitrate, nitrite, sulfate [SW846 Method 9056] and methane, ethane, ethene [RSK-175]) will also be analyzed for samples from wells ET-3 and C-001 in order to evaluate the effectiveness of natural attenuation in groundwater where PCP and chlorinated solvents have exhibited concentrations above MCLs.
- As requested by EPA, sampling of dioxins/furans will be included at designated well(s) as follows: Biased locations at potential source area (ET-3) and closest downgradient locations in shallow aquifer (C-003) and deep aquifer (IDA-MW1). Samples from C-003 and IDA-MW1 will only be analyzed if there are detections above screening levels in ET-3.
- Gross alpha/beta activity, radionuclides, TOC, and TOX will not be included in the RI sampling. As discussed earlier, gross alpha/beta activity has been detected below MCLs and any isolated exceedances have been attributed to turbid samples. TOC and TOX have also indicated stable trends. Since individual COCs will be analyzed in both the shallow and deep aquifer wells, TOC and TOX are not deemed necessary as part of this sampling event. Gross alpha/beta activity, radionuclides, TOC, and TOX will continue to be included in the LTM program.

- During the past 43 rounds of groundwater sampling, groundwater elevations for the IDA wells were collected during different seasons as documented in Appendix A of the most recent Annual Groundwater Monitoring Report (Aerostar, 2018). Groundwater elevation data was collected during the months of January, February, March, April, May, September, and November during the first 7 rounds of sampling. During sampling rounds 8-33, semi-annual groundwater elevation data was collected in April, May, June, and November. During sampling rounds 34-40, annual groundwater elevation data was measured in May. During Rounds 41, 42, and 43 the groundwater elevation data was measured in November, April, and May, respectively. No seasonal trends were observed in a comprehensive review of the historical data prior to Round 33 (Aerostar, 2018). A qualitative review of the data during the development of this QAPP showed a consistent trend in groundwater elevations. Thus, there is no specific optimal time to conduct the comprehensive sampling event and the sampling event will be scheduled following QAPP approval. The critical goal is collection of comprehensive data from the shallow and deep aquifers as a snapshot in time.

Conceptual Exposure Model

Based on the understanding of site conditions, Figure IDA-10-16 presents the conceptual exposure model (CEM) for human and ecological receptors, as appropriate. The Potential Exposure Scenarios summary table at the bottom of Figure IDA-10-16 shows the receptors, potential exposure activity, and exposure media and pathways. The maintenance worker is the most likely current and future human receptor and as Figure IDA-10-16 indicates there are no complete pathways for this receptor since the landfill is covered by caps in accordance with the Action Memorandum for the Inert Landfill and the 2008 OU4 IROD and land use controls have been implemented in accordance with the 2008 OU4 IROD. There are potentially complete exposure pathways for ecological receptors from sediment/soil at the former sedimentation ponds. Existing sediment/soil data will be used in a Screening-Level Ecological Risk Assessment (SLERA) to evaluate the potential for ecological risk to terrestrial receptors. The existing soil/sediment data from these ponds will be screened versus the appropriate media-specific ecological screening values, which account for multiple receptors. Existing surface water data will only be evaluated qualitatively; permanent water bodies do not exist, as engineering controls were implemented in 2011 to ensure that the ponds do not maintain standing water by drilling drain holes in each of the standpipes in the sediment ponds. Two of these former sedimentation ponds are located outside of the IDA fence boundary that was installed in 2016. There are no significant exposure pathways from soil for ecological receptors at the IDA. While the LUCs are not intended to directly protect ecological receptors, maintenance of the cover/cap system, IDA boundary fencing, and routine inspections reduce the likelihood that ecological receptors would utilize the limited habitat at the IDA. The SLERA will discuss why exposures are not expected to be significant to constituents under the cover/cap system. The CEMs included in this Uniform Federal Policy–Quality Assurance Project Plan (UFP-QAPP) are preliminary and were developed based on the current understanding of site conditions. However, the CEMs will be refined, as needed, as additional site-specific information is obtained. Revised CEMs will be provided for review within a human health risk assessment (HHRA) interim deliverable to be provided prior to completion of the RI.

Regulatory Setting

The IAAAP, a Defense Environmental Restoration Program (DERP) property managed under the IRP, is on the National Priorities List (NPL) and follows the CERCLA process, as amended by the Superfund Amendments and Reauthorization Act (SARA), National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requirements, and RCRA. In accordance with the 1990 Federal Facility Agreement (FFA), the Army, as the lead agency for the IAAAP, is conducting CERCLA response obligations and RCRA corrective action obligations at IAAAP as it relates to the release of hazardous substances, hazardous wastes, pollutants, or contaminants covered by the FFA. The Army Material Command (AMC) is the agency responsible for cleanup activities at the IAAAP, which is currently operated by a government contractor-operator (America Ordnance, LLC). Through the FFA, the Army works with the USEPA, the lead regulatory agency, with support provided by Iowa Department of Natural Resources (IDNR).

In accordance with the FFA, CERCLA response actions, if deemed applicable or relevant and appropriate, will meet or eliminate the need for further corrective actions under RCRA. If corrective actions are deemed necessary, RCRA requirements will be retained as Applicable or Relevant and Appropriate Requirements (ARARs) pursuant to Section 121 of CERCLA.

The Army understands that active engagement and close coordination with the USEPA is critical in attaining integration of CERCLA and RCRA requirements applicable at the IDA. The closure of the RCRA Ash Disposal Cell in Trench 5 specifically falls under the RCRA regulatory framework. The Ash Disposal Cell was originally closed with a RCRA clay cover in 1989 in accordance with the Closure and Post-Closure Plans for Trench No. 5 of the Inert Landfill (USACE, 1988). The ILF Trenches 1-5 were initially intended to be closed according to IDNR requirements and a Closure Plan was submitted in October 1994. In December 1994, the IDNR elected to defer oversight of the ILF Trenches 1-5 response action to EPA under terms of the FFA with the Army. The state landfill closure requirements were identified as an ARAR for the CERCLA response action outlined in the Action Memorandum for the Inert Landfill (CDM, 1997).

In 1998, during CERCLA closure of ILF Trenches 1-5, the Ash Disposal Cell was provided additional protection via the synthetic cover system that was placed over ILF Trenches 1-5. In March 1994, the USEPA issued a RCRA CA/CO which required an accelerated groundwater assessment in the Trench 5 area. In June 1995, following the Army's completion of the initial assessment, the USEPA indicated that the contamination may not be from the wastes disposed of at the RCRA portion of Trench 5 (USEPA, 1995). The USEPA requested the Army to continue groundwater sampling on a semiannual basis and deferred further assessment of the groundwater until completion of interim actions being undertaken pursuant to CERLCA (USEPA, 1995). The USEPA approval letter for the accelerated groundwater assessment report specified a groundwater sampling and analysis plan (SAP) for the Army in order to comply with post-closure requirements of the closed RCRA Ash Disposal Cell (USEPA, 1995). The SAP included a combination of shallow “drift” aquifer wells and deeper “bedrock” aquifer wells at the IDA that were to be monitored on a semi-annual basis.

In March 2012, pursuant to the 1997 Amendment to Closure/Post Closure Plan for the IDA, the Army stated its intent to monitor the IDA as a singular landfill site under CERCLA upon completion of the IDA closure actions, including RCRA closure monitoring for Trench 5 (DOA, 2012). In September 2012, the USEPA notified the Army that ceasing compliance with the post-closure plan for Trench 5 located at the IDA would be in violation of RCRA regulations. The USEPA also stated that the activities outlined in Volume 4 of the RACR regarding operation and maintenance, LTM, and LUCs for the IDA were not fully sufficient to meet RCRA post-closure care requirements for Trench 5. The USEPA requested additional wells to establish groundwater point of compliance at the limits of the various landfill caps at the IDA. The RCRA/CERCLA integration and the need for additional wells have been discussed between the Army and USEPA in subsequent technical project planning (TPP) meetings. The list of existing wells in the monitoring program, the sampling suite of analytes, and the annual sampling frequency have been maintained since 2012. The RCRA closure monitoring of Trench 5 was conducted on a semi-annual basis from 1996 to 2007 and has continued on an annual basis from 2007 through 2017. Note that while the annual monitoring results are provided in the context of the RCRA Trench 5 Monitoring, the results represent groundwater monitoring of the entire IDA including CERCLA Trench 6 and CEA monitoring.

RCRA Monitoring Network

The current monitoring well network includes a total of 23 monitoring wells (17 in the overburden [glacial till or glacial outwash] aquifer and 6 in the bedrock aquifer). However, the current LTM program consists of sampling 13 wells and a surface water location for selected analytes along with three wells for TOC and TOX. The LTM program was last evaluated and optimized in 2007. Hydrogeologic conditions at the IDA indicate significantly low hydraulic conductivities (e.g., horizontal conductivity of 5.5E-05 cm/sec and vertical conductivity of 2.8E-09 cm/sec) in the glacial till, resulting in very slow groundwater movement (8 to 26 feet/year) in the shallow “drift” aquifer and a low potential for contaminant migration to the deeper “bedrock” aquifer. ILF Trenches 1-5, Trench 6, and CEA, have been closed with RCRA type covers which further limit infiltration of surface water. Based on the technical discussions with stakeholders at the TPP meetings in 2016 and 2017, the Army believes that a comprehensive evaluation of groundwater data from all IDA wells, as described above, may be warranted to provide a current snapshot of the groundwater quality throughout the IDA. This would assist in further optimizing the groundwater monitoring program and determining if there were any coverage gaps.

Based on groundwater assessment and monitoring results for the IDA for the past 20 plus years, the Army also believes that the current network of monitoring wells in the shallow “drift” aquifer and the deeper “bedrock” aquifer provides adequate coverage under the groundwater monitoring system requirements listed in 40 Code of Federal Regulations (CFR) Subpart F [§264.97(a)(2), (b), and (c)] and 40 CFR Subpart N [§264.310(b)(4)]. Note that the Subpart F and N requirements do not specify the number of wells or spacing frequency for detection or compliance monitoring well networks. Stable groundwater contaminant trends and consistent groundwater gradients have been observed in the shallow “drift” and deeper “bedrock” aquifers at the IDA. While the Army acknowledges the stakeholder concerns regarding lateral spacing of existing wells, the Army also believes that it may be premature to discuss the need for and placement of any additional monitoring wells at the IDA until a comprehensive groundwater quality assessment is performed.

RCRA/CERCLA Integration

The 1989 closure of the RCRA Ash Disposal Cell was conducted in accordance with appropriate RCRA cover requirements along with post-closure monitoring requirements. The 1998 closure of ILF Trenches 1-5 were conducted as a non-time critical removal under CERCLA and a RCRA cover type was used. The subsequent closure of Trench 6, Trench 7, and the CEA from 2009 to 2011 were all conducted in accordance with the 2008 OU4 IROD, which included groundwater monitoring requirements.

Contaminated soil from CERCLA removal actions at OU1 sites at the IAAAP was disposed in Trench 6 and the CEA prior to closure capping activities at those areas. The low-level contaminated soils (soils with cumulative excess cancer risk less than 10^{-6}) were also used to cover the ILF to provide an appropriate grade as a base for the RCRA synthetic cover installed at the ILF in 1998. From 1991 through 1995, a CERCLA SI and RI were conducted at the IDA; this included soil and groundwater investigations of the Former Blue Sludge Lagoon, Former Burning Ground, Former Sludge Drying Bed/Holding Pond, and Former Metal Storage Yard, and groundwater investigation of ILF Trenches 1-5. Prior to the capping of ILF Trenches 1-5, NTCRA at the Former Blue Sludge Lagoon, Former Burning Ground, and Former Sludge Drying Bed/Holding Pond had been conducted. The nature and extent of contamination has been investigated at ILF Trenches 1-5 and the RCRA Ash Disposal Cell by installation of monitoring wells within and around the ILF. While multiple wells (T-1, T-2, T-3, T-6, T-7, T-8, ET-1, ET-2, and ET-3) were installed to investigate Trench 5 and the Ash Disposal Cell, two wells (JAW-66 and JAW-67) were installed at Trenches 3 and 4. All of these wells, with the exception of ET-3, were abandoned between 1996 and 1998 prior to the capping of ILF Trenches 1-5. Although there is no evidence of intrusive investigation within Trenches 1 and 2, the surrounding wells (G-4, JAW-26, and JAW-65) provide sufficient information in the crossgradient and upgradient direction from Trenches 1 and 2. Intrusive soil or groundwater investigation within the existing closed footprint of ILF Trenches 1-5 is not recommended or necessary given historical investigations and the existing network of monitoring wells surrounding the IDA. However, the excavation boundaries of the NTCRAs for Former Burning Ground, Former Blue Sludge Lagoon, Former Sludge Drying Beds, in accordance with the Action Memorandum for the Inert Disposal Area (CDM, 1997), that were outside the ILF/CEA footprint should be documented in a CERCLA document. Documentation of these excavation boundaries will be based on the availability of historical information and will be provided, if available, in the OU4 RI and ROD.

As previously mentioned there are 23 existing monitoring wells at the IDA. Accessibility and topography are limiting factors to additional well installation in certain areas around the IDA. The existing shallow overburden wells (C-95-1, JAW-65, JAW-26, and G-6R) provide sufficient crossgradient coverage on the southeastern boundary of ILF Trenches 1-5 and the CEA, and additional shallow wells in that area do not appear necessary. While the footprint of the CEA cap is known based on the as-built drawings for the CEA, the extent of the RCRA synthetic cover at the ILF is not known. It is not be feasible to install well(s) between the RCRA caps for ILF Trenches 1-5 and the CEA due to the possibility of damaging the integrity of the synthetic cover. The existing shallow overburden wells (C-00-3, G-5, IDA-TT-MW1, G-7, C95-2, C-00-1, and C-00-2) provide adequate coverage to the southwest and downgradient of ILF Trenches 1-5, the Trench 6 Landfill, and the CEA, and additional shallow overburden wells in that area do not appear necessary. Surface water sampling at the CEA-POOL-UPSTR location was initiated on the upstream side of the former CEA Sedimentation Pond in lieu of installing an additional well downgradient of JAW-27 because the area downgradient of JAW-27 is unsuitable of installation of an additional well. As discussed previously, the historical data for the deeper “bedrock” wells have demonstrated that vertical migration of groundwater contaminants from the shallow “drift” aquifer to the deeper “bedrock” aquifer appears to be very limited (i.e., BEHP). Therefore, additional deeper “bedrock” aquifer wells do not appear to be necessary at this time. The Army believes that it may be premature to discuss the need for and placement of any additional monitoring wells at the IDA until the comprehensive evaluation is conducted. Prior to the SRI, the results of the proposed comprehensive sampling will be evaluated and the CSM will be updated to evaluate if there are any further data coverage gaps in the LTM network. If data gaps are identified, additional well(s) will be installed and sampled and the resulting data will be included in the SRI. Groundwater monitoring of the IDA, including the RCRA Trench 5 post-closure monitoring and CERCLA LTM monitoring in accordance with the OU4 IROD, will continue as per the current LTM program requirements.

Data Quality Objectives

The SRI will evaluate the nature and extent of contamination, fate and transport of contamination, and recommend a path forward consistent with the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final* (USEPA, 1988). DQOs are as summarized in Table IDA-11-1. The specific tasks that will be performed during the RI are described in IDA Worksheet #14. The rationale behind the steps outlined in Table IDA-11-1 is presented in detail in IDA Worksheet #17.

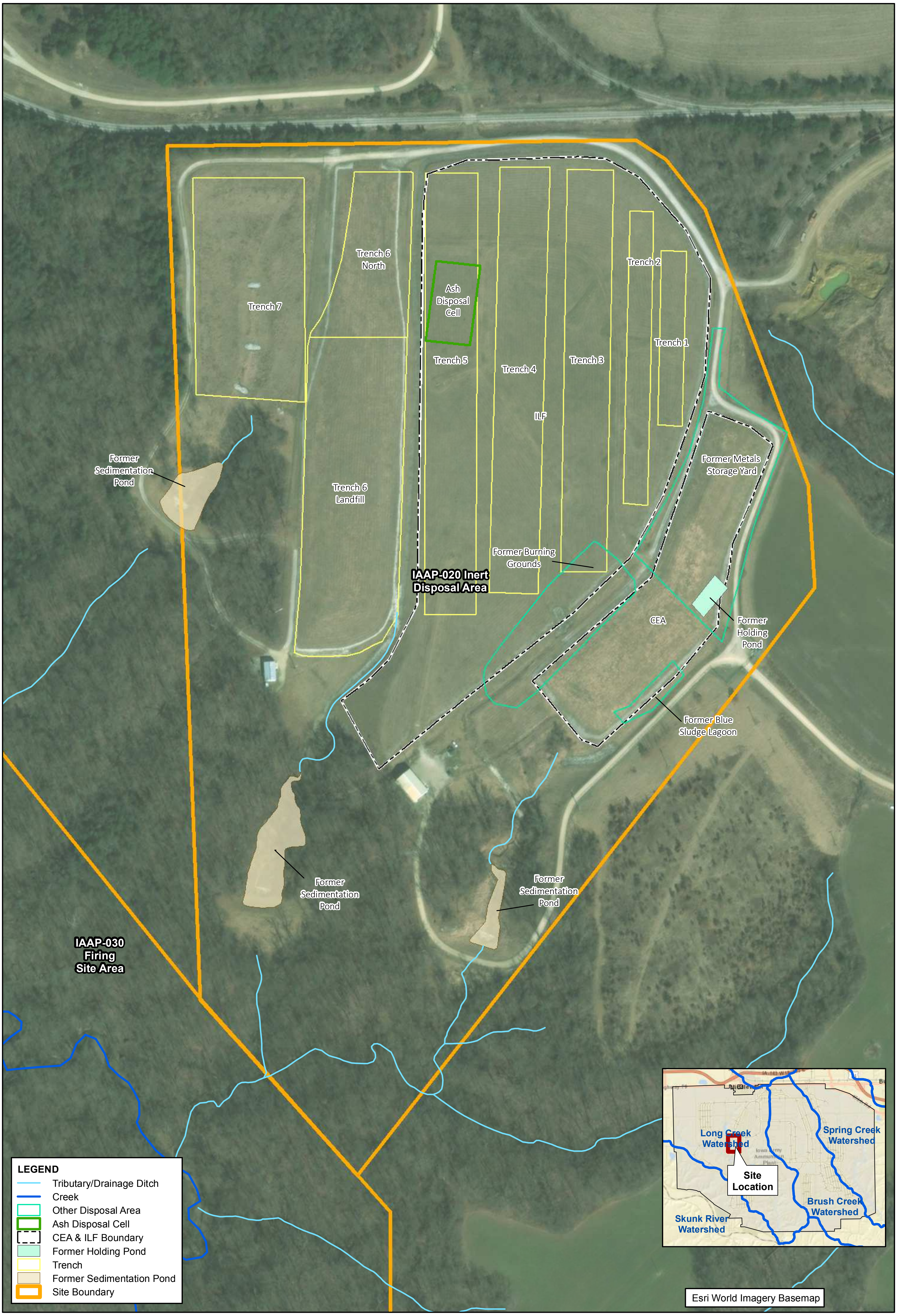

FIGURE IDA-10-1
IAAP-020 Inert Disposal Area Site Layout
Iowa Army Ammunition Plant
Middletown, Iowa

SCO W:\IAAAP IRP\GIS\QAAP\DRAFT QAAP\PACKET 1\IAAP-020\FIGURE IDA-10-1 SITE LAYOUT.MXD CASELTONA 4/10/2018 10:16:47 AM

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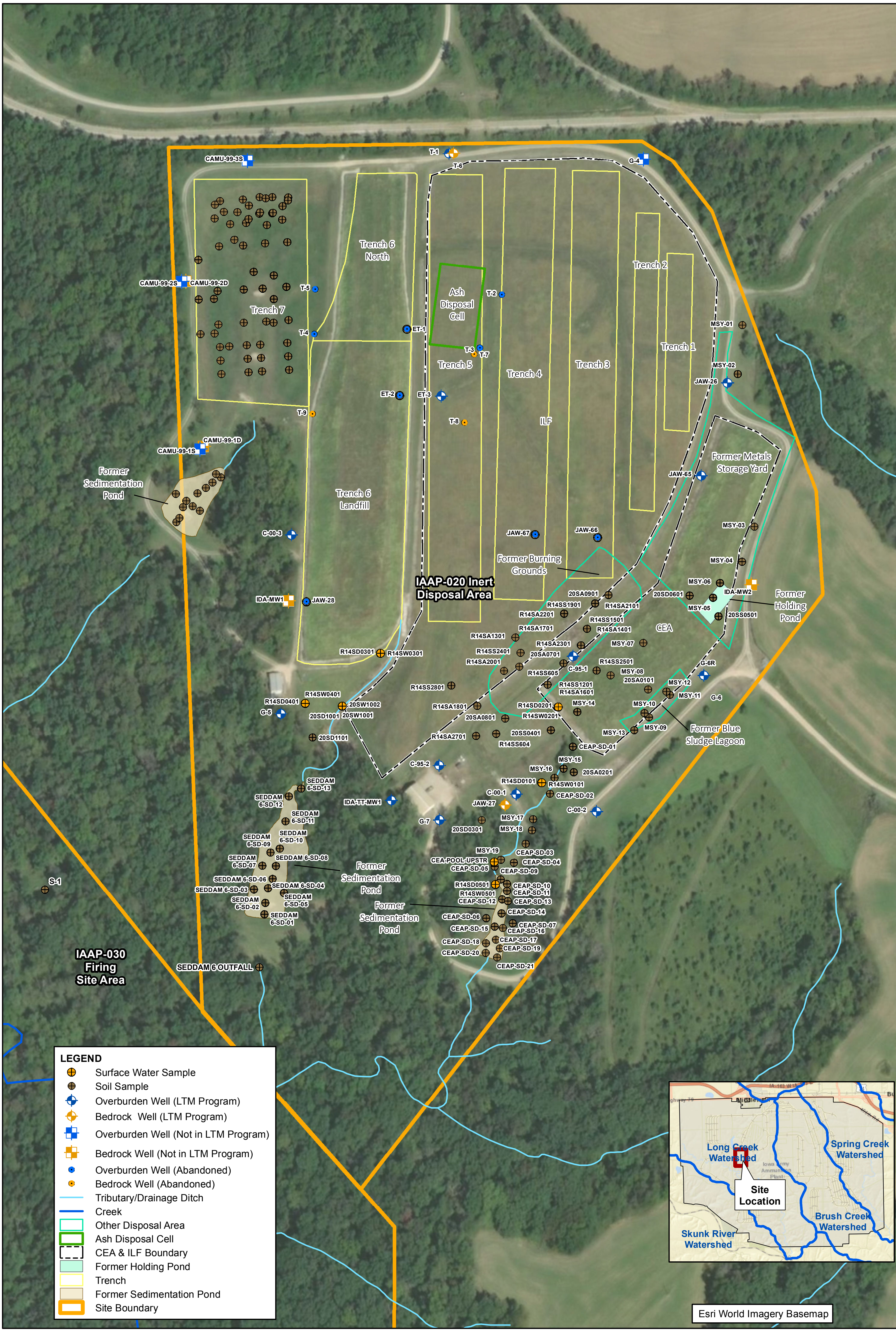


Note: North Former Sedimentation Pond & Trench 7 Soil labels are on figure IDA-10-2b.

0 200
Feet

N

FIGURE IDA-10-2a
IAAP-020 Inert Disposal Area
Historical Sample Locations
Iowa Army Ammunition Plant
Middletown, Iowa

ch2m

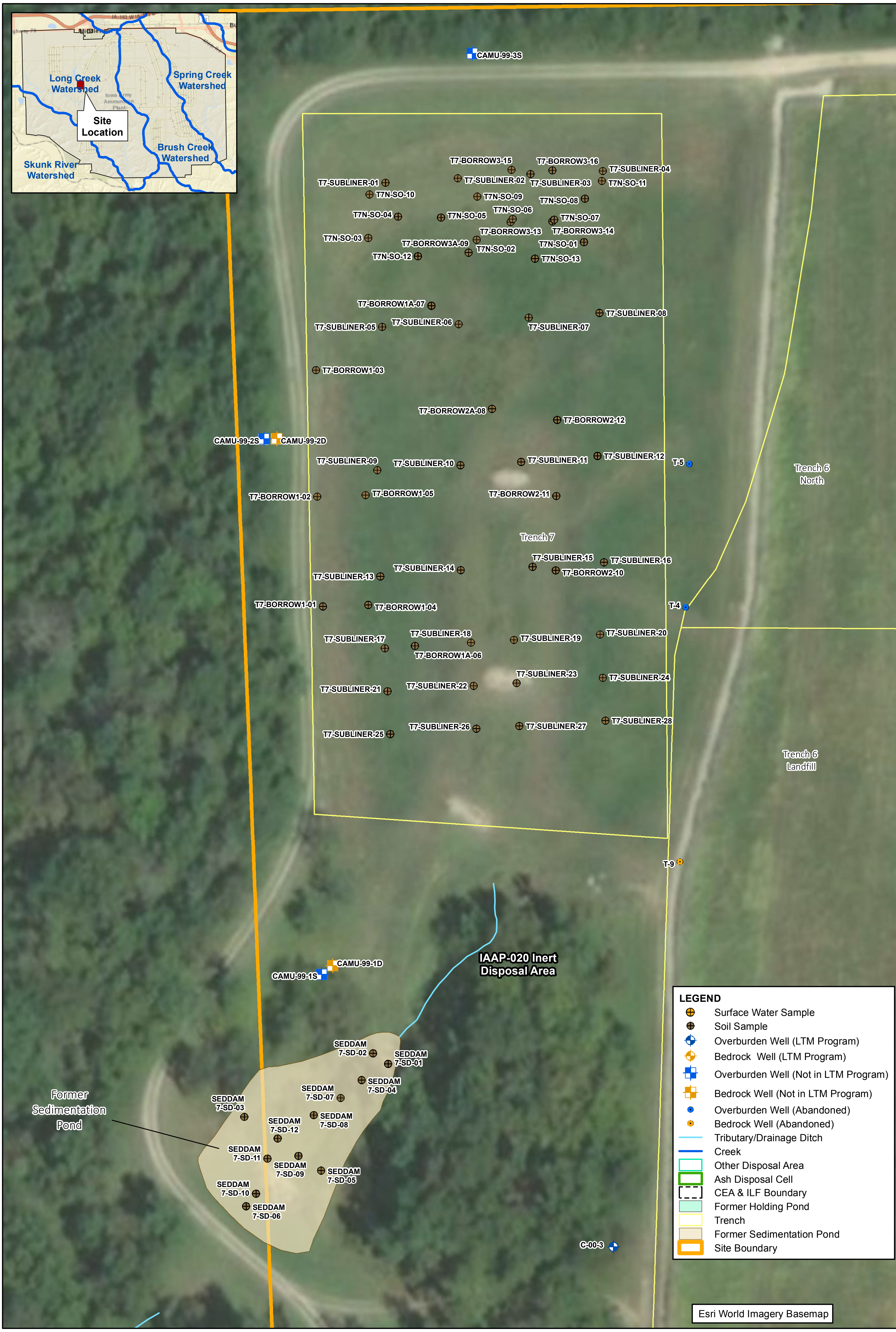


FIGURE IDA-10-2b
IAAP-020 Inert Disposal Area
Historical Sample Locations
Iowa Army Ammunition Plant
Middletown, Iowa

N

0 50
Feet

ch2m

SCO W:\IAAAP IRP\GIS\QAAP\DRAFT QAAP\PACKET 4\FIGURE IDA-10-2B HISTORICAL SAMPLE LOCATIONS.MXD CASELTONA 8/23/2018 1:18:19 PM

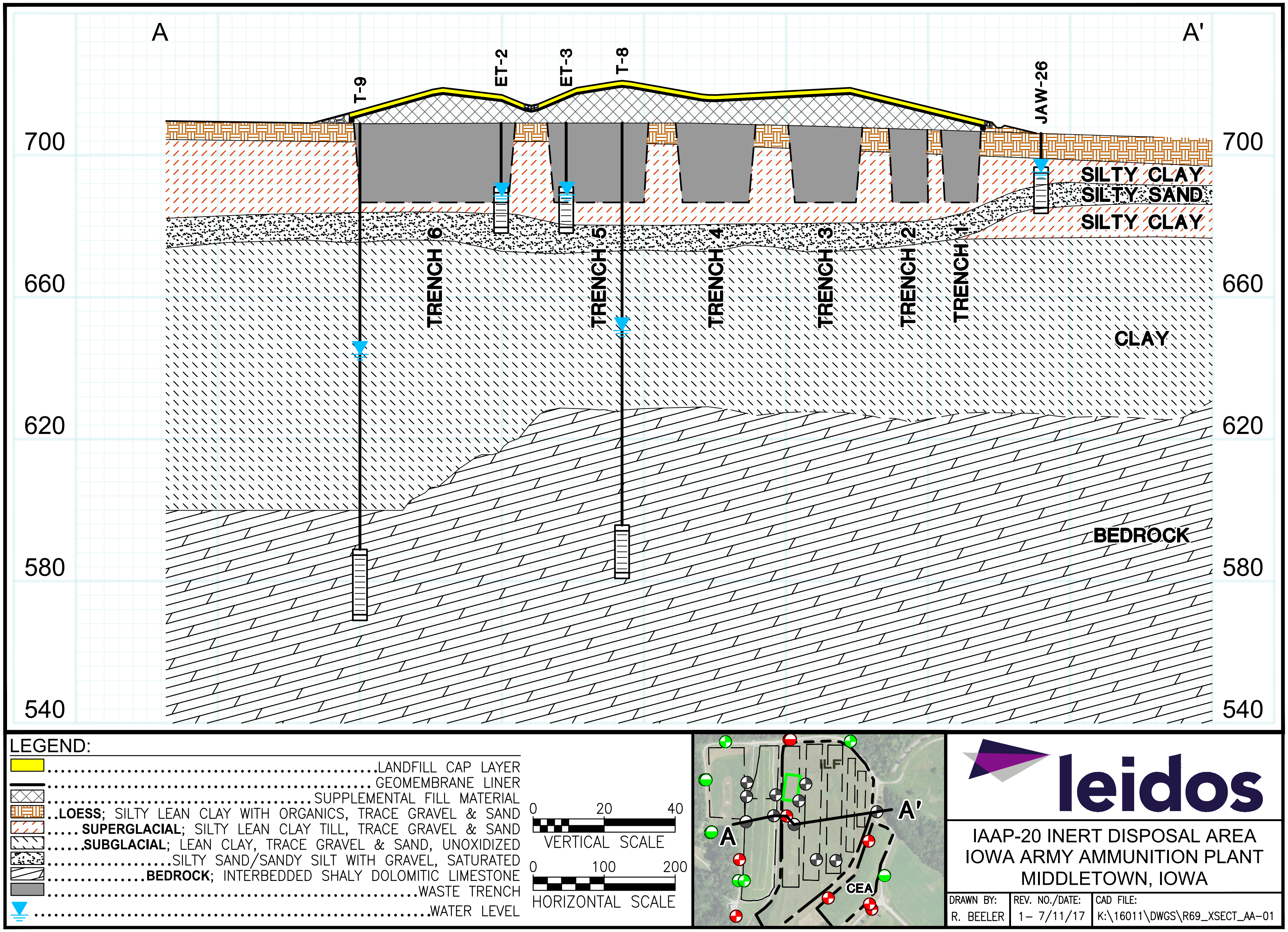


Figure IDA-10-3. IAAP-020 Inert Disposal Area Cross-Section A-A'

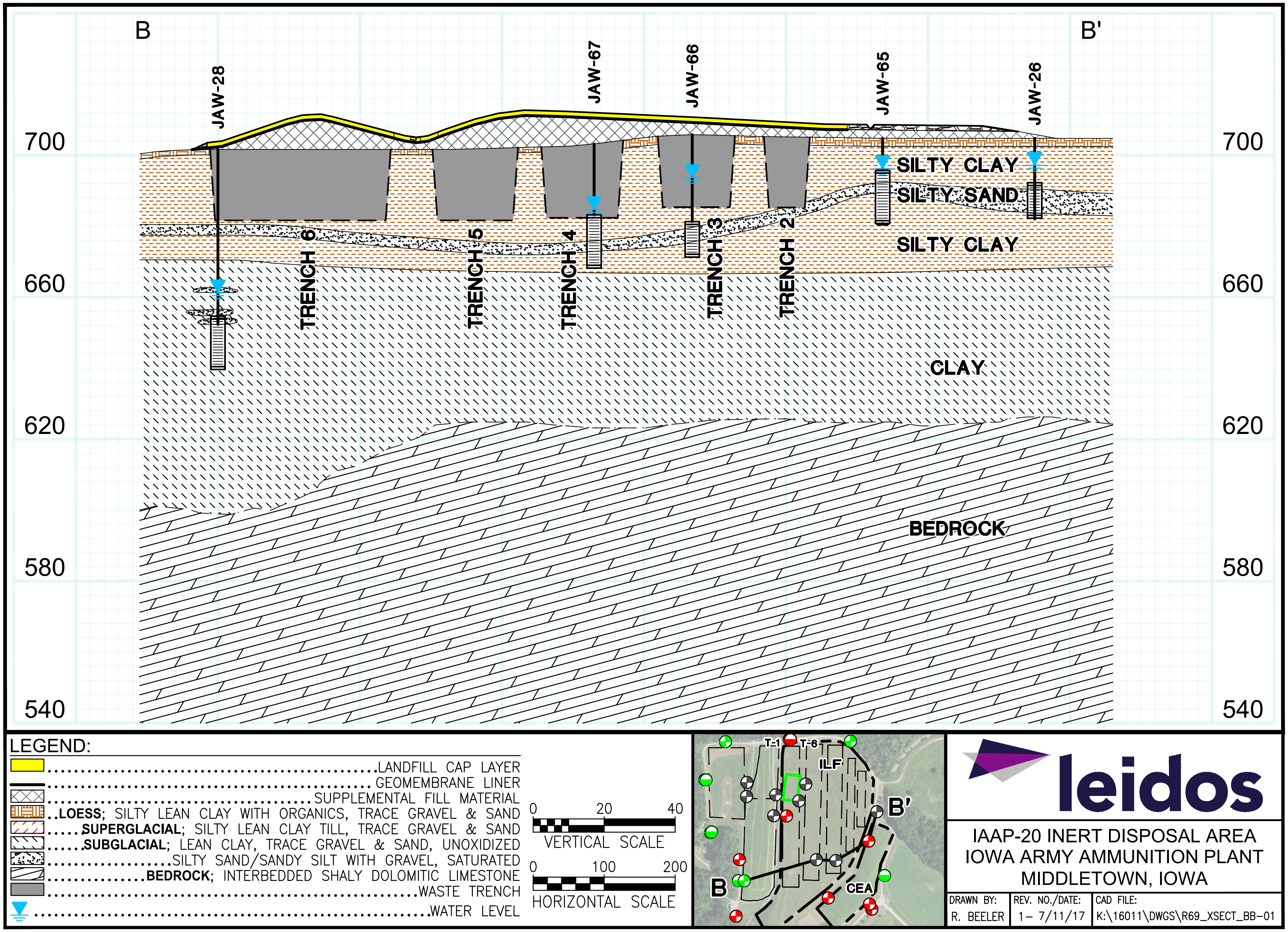


Figure IDA-10-4. IAAP-020 Inert Disposal Area Cross-Section B-B'

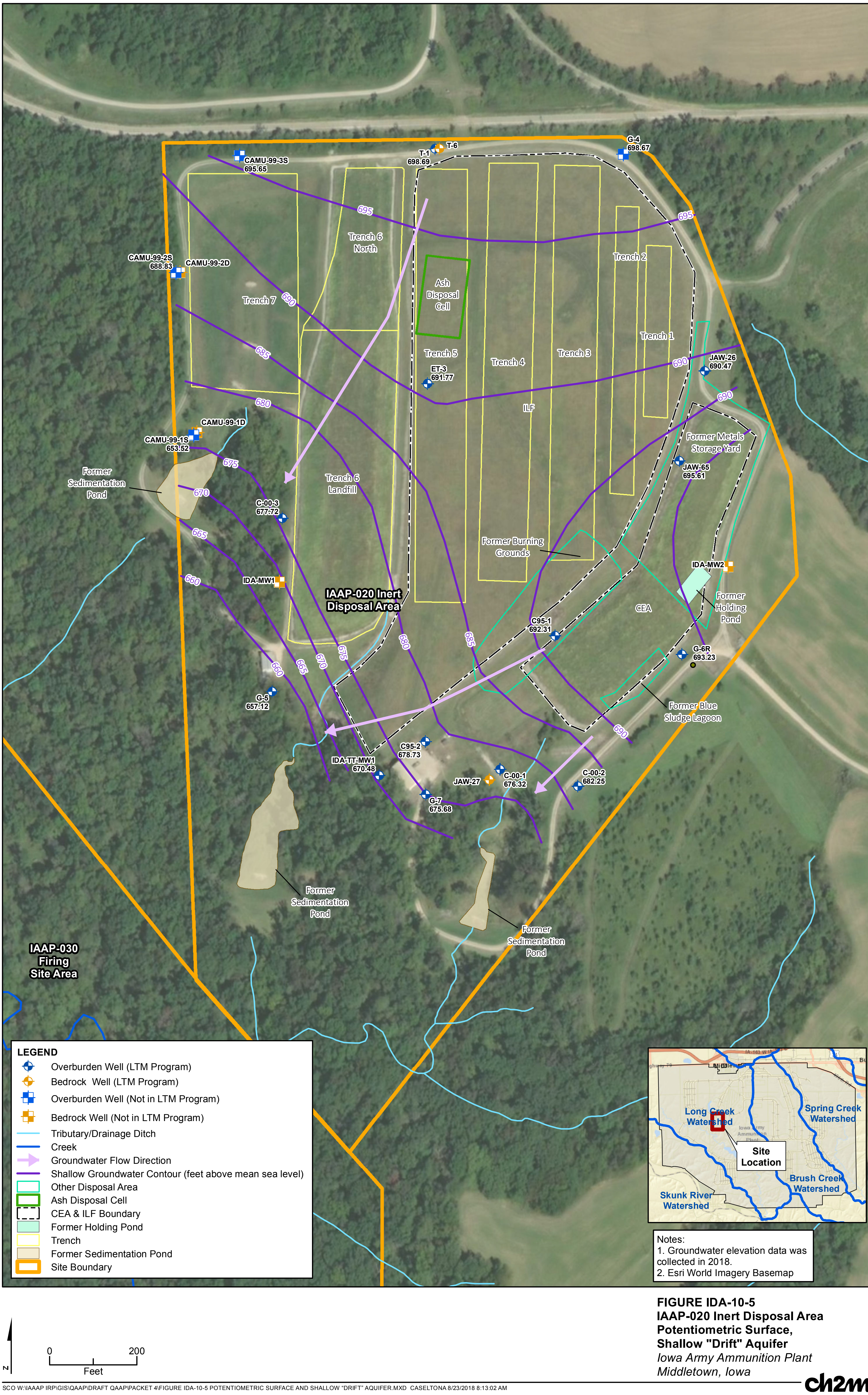


FIGURE IDA-10-5
IAAP-020 Inert Disposal Area Potentiometric Surface, Shallow "Drift" Aquifer
Iowa Army Ammunition Plant
Middletown, Iowa

ch2m

SCO W:\IAAAP IRP\GIS\QAAP\DRAFT QAAP\PACKET 4\FIGURE IDA-10-5 POTENTIOMETRIC SURFACE AND SHALLOW "DRIFT" AQUIFER.MXD CASELTONA 8/23/2018 8:13:02 AM

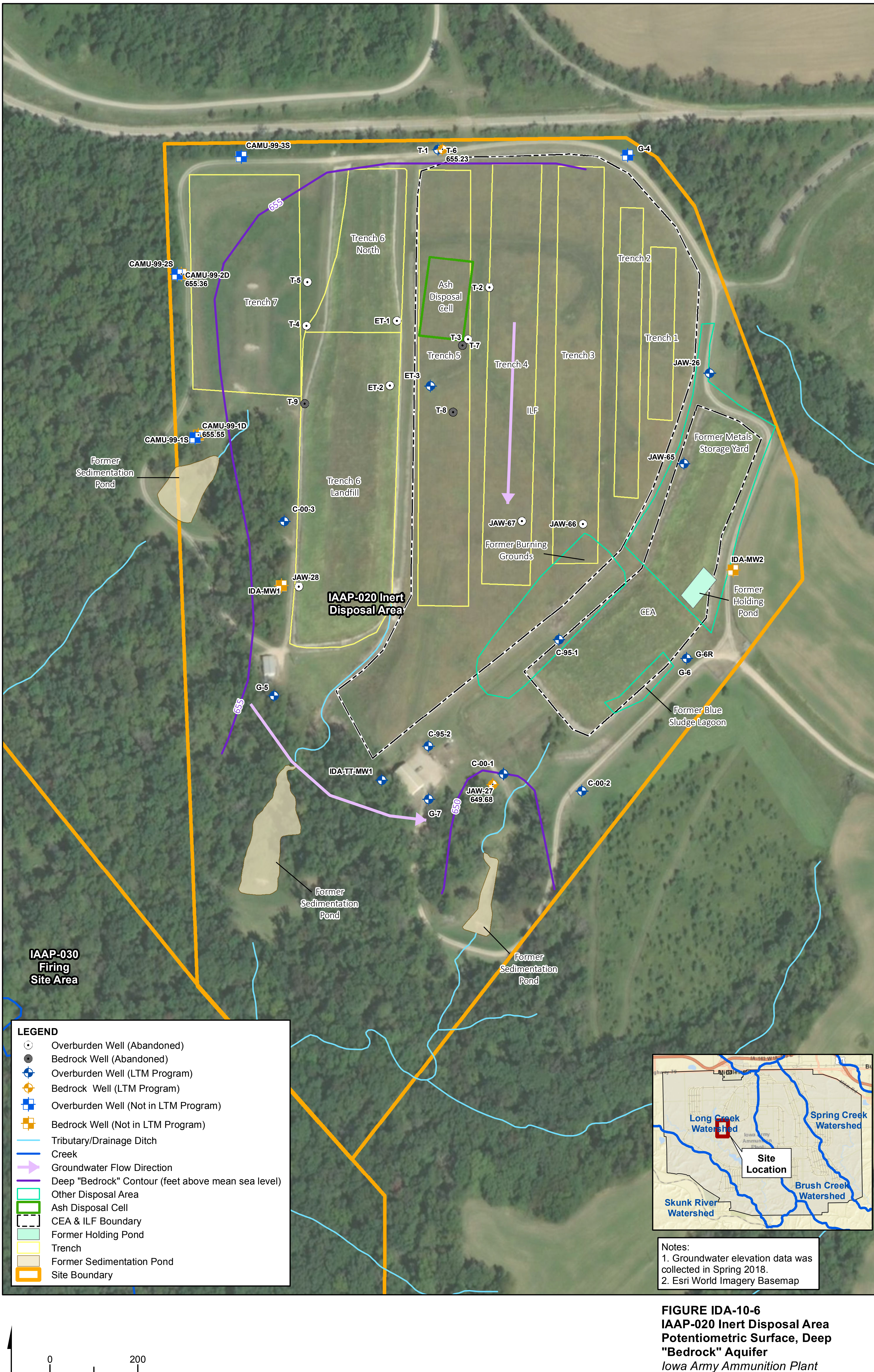
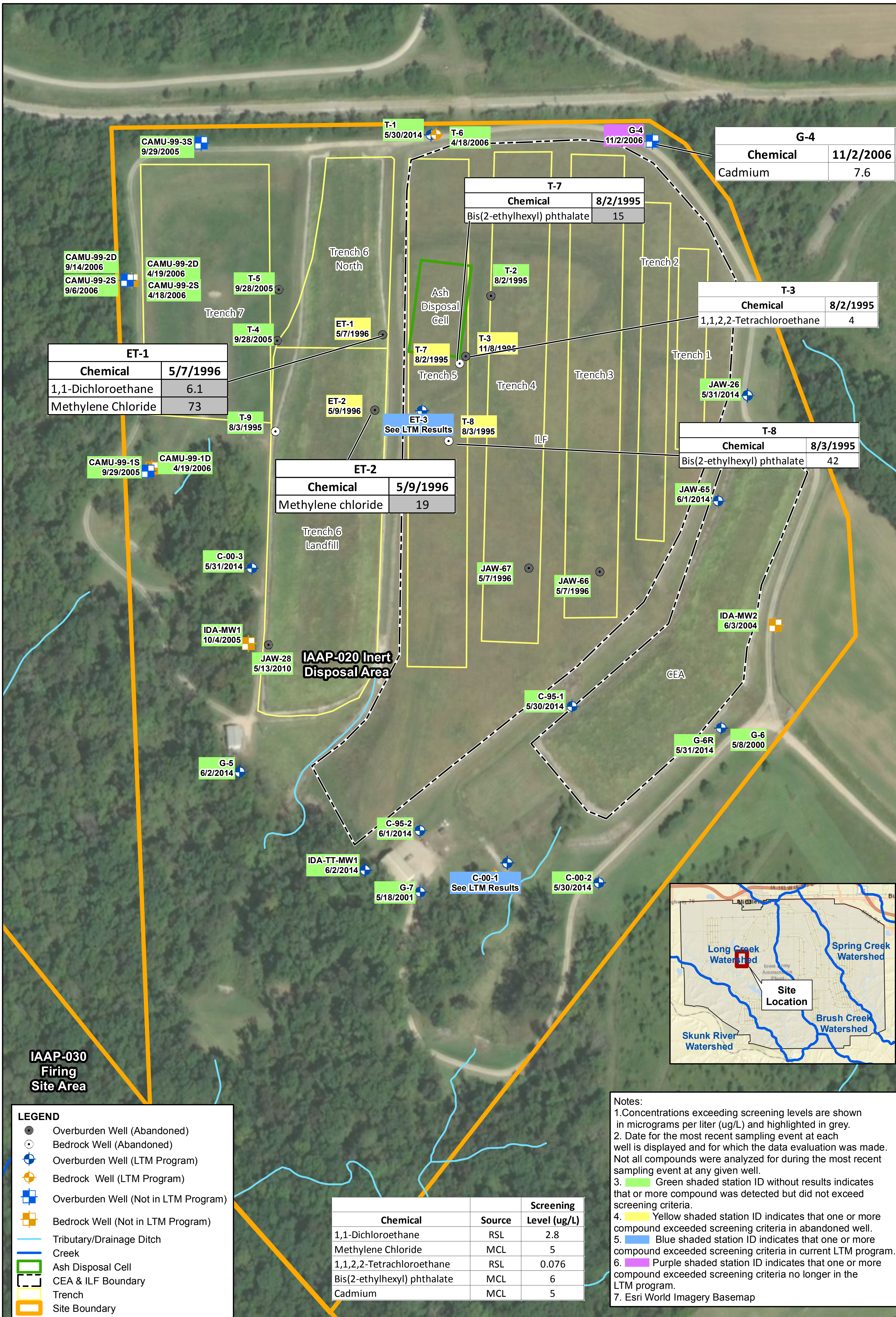


FIGURE IDA-10-6
IAAP-020 Inert Disposal Area Potentiometric Surface, Deep "Bedrock" Aquifer
Iowa Army Ammunition Plant
Middletown, Iowa

ch2m

SCO W:\IAAAP IRP\GIS\QAAP\DRAFT QAAP\PACKET 4\FIGURE IDA-10-6 POTENTIOMETRIC SURFACE AND DEEP BEDROCK AQUIFER.MXD CASELTONA 8/23/2018 10:29:06 AM



G-4	
Chemical	11/2/2006
Cadmium	7.6

T-7	
Chemical	8/2/1995
Bis(2-ethylhexyl) phthalate	15

T-3	
Chemical	8/2/1995
1,1,2,2-Tetrachloroethane	4

ET-1	
Chemical	5/7/1996
1,1-Dichloroethane	6.1
Methylene Chloride	73

T-8	
Chemical	8/3/1995
Bis(2-ethylhexyl) phthalate	42

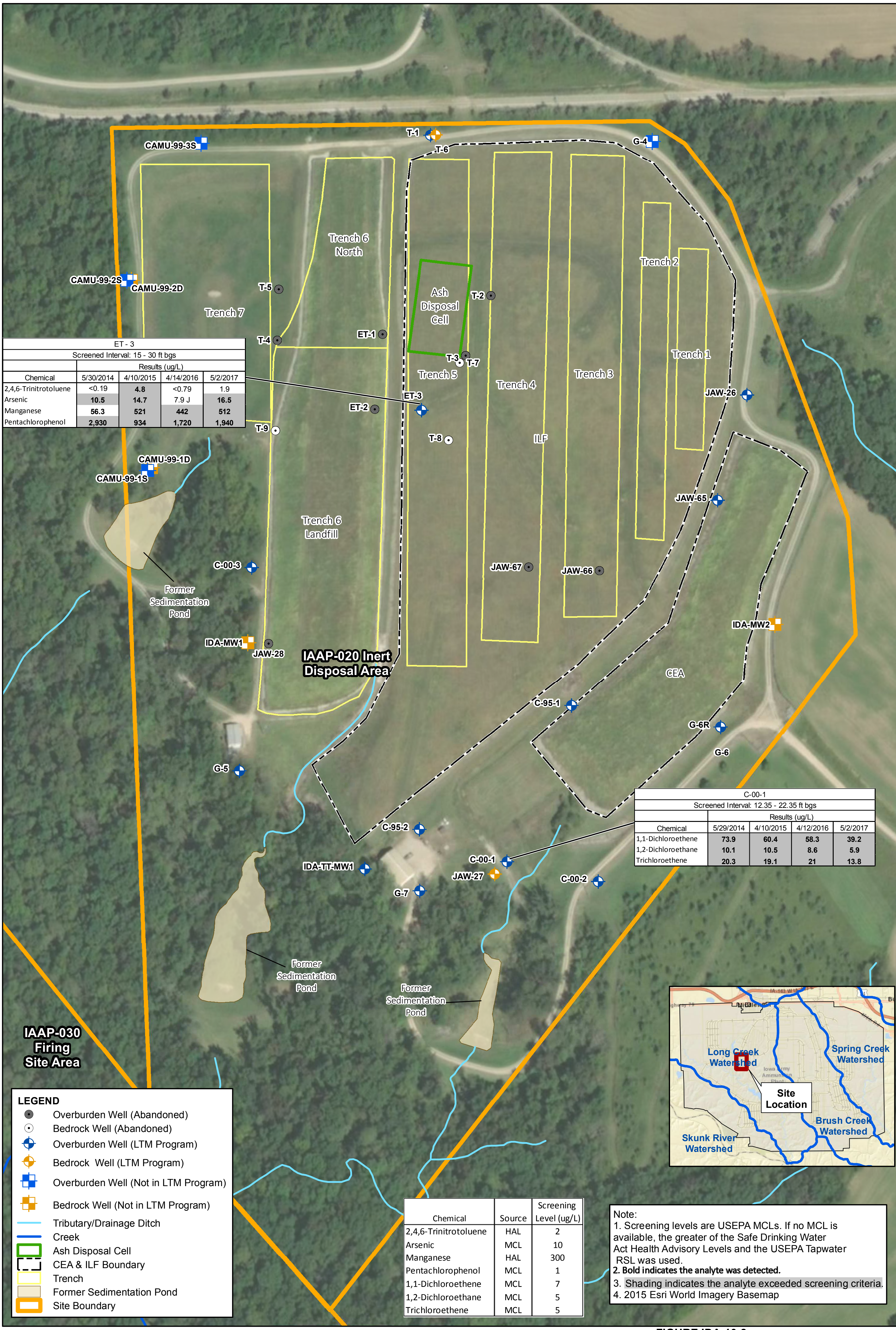
ET-2	
Chemical	5/9/1996
Methylene chloride	19

Chemical	Source	Screening Level (ug/L)
1,1-Dichloroethane	RSL	2.8
Methylene Chloride	MCL	5
1,1,2,2-Tetrachloroethane	RSL	0.076
Bis(2-ethylhexyl) phthalate	MCL	6
Cadmium	MCL	5

Notes:
1. Concentrations exceeding screening levels are shown in micrograms per liter (ug/L) and highlighted in grey.
2. Date for the most recent sampling event at each well is displayed and for which the data evaluation was made. Not all compounds were analyzed for during the most recent sampling event at any given well.
3. Green shaded station ID without results indicates that or more compound was detected but did not exceed screening criteria.
4. Yellow shaded station ID indicates that one or more compound exceeded screening criteria in abandoned well.
5. Blue shaded station ID indicates that one or more compound exceeded screening criteria in current LTM program.
6. Purple shaded station ID indicates that one or more compound exceeded screening criteria no longer in the LTM program.
7. Esri World Imagery Basemap

Figure IDA-10-7
IAAP-020-Inert Disposal Area
Groundwater Exceedances from the Most Recent Sampling Event
Iowa Army Ammunition Plant
Middletown, Iowa

ch2m:



ET - 3				
Screened Interval: 15 - 30 ft bgs				
	Results (ug/L)			
Chemical	5/30/2014	4/10/2015	4/14/2016	5/2/2017
2,4,6-Trinitrotoluene	<0.19	**4.8**	<0.79	1.9
Arsenic	**10.5**	**14.7**	7.9 J	**16.5**
Manganese	**56.3**	**521**	**442**	**512**
Pentachlorophenol	**2,930**	**934**	**1,720**	**1,940**

C-00-1				
Screened Interval: 12.35 - 22.35 ft bgs				
	Results (ug/L)			
Chemical	5/29/2014	4/10/2015	4/12/2016	5/2/2017
1,1-Dichloroethene	**73.9**	**60.4**	**58.3**	**39.2**
1,2-Dichloroethane	**10.1**	**10.5**	**8.6**	**5.9**
Trichloroethene	**20.3**	**19.1**	**21**	**13.8**

Chemical	Source	Screening Level (ug/L)
2,4,6-Trinitrotoluene	HAL	2
Arsenic	MCL	10
Manganese	HAL	300
Pentachlorophenol	MCL	1
1,1-Dichloroethene	MCL	7
1,2-Dichloroethane	MCL	5
Trichloroethene	MCL	5

Note:
1. Screening levels are USEPA MCLs. If no MCL is available, the greater of the Safe Drinking Water Act Health Advisory Levels and the USEPA Tapwater RSL was used.
2. **Bold indicates the analyte was detected.**
3. Shading indicates the analyte exceeded screening criteria.
4. 2015 Esri World Imagery Basemap

FIGURE IDA-10-8
IAAP-020-Inert Disposal Area
2014 through 2017 Long Term Monitoring Groundwater Data Exceeding Screening Criteria
Iowa Army Ammunition Plant
Middletown, Iowa

SCO W:\IAAAP IRP\GIS\QAAP\DRAFT QAAP\PACKET 4\FIGURE IDA-10-8 GW SAMPLES 2017 RESULTS.MXD CASELTONA 8/22/2018 2:06:05 PM

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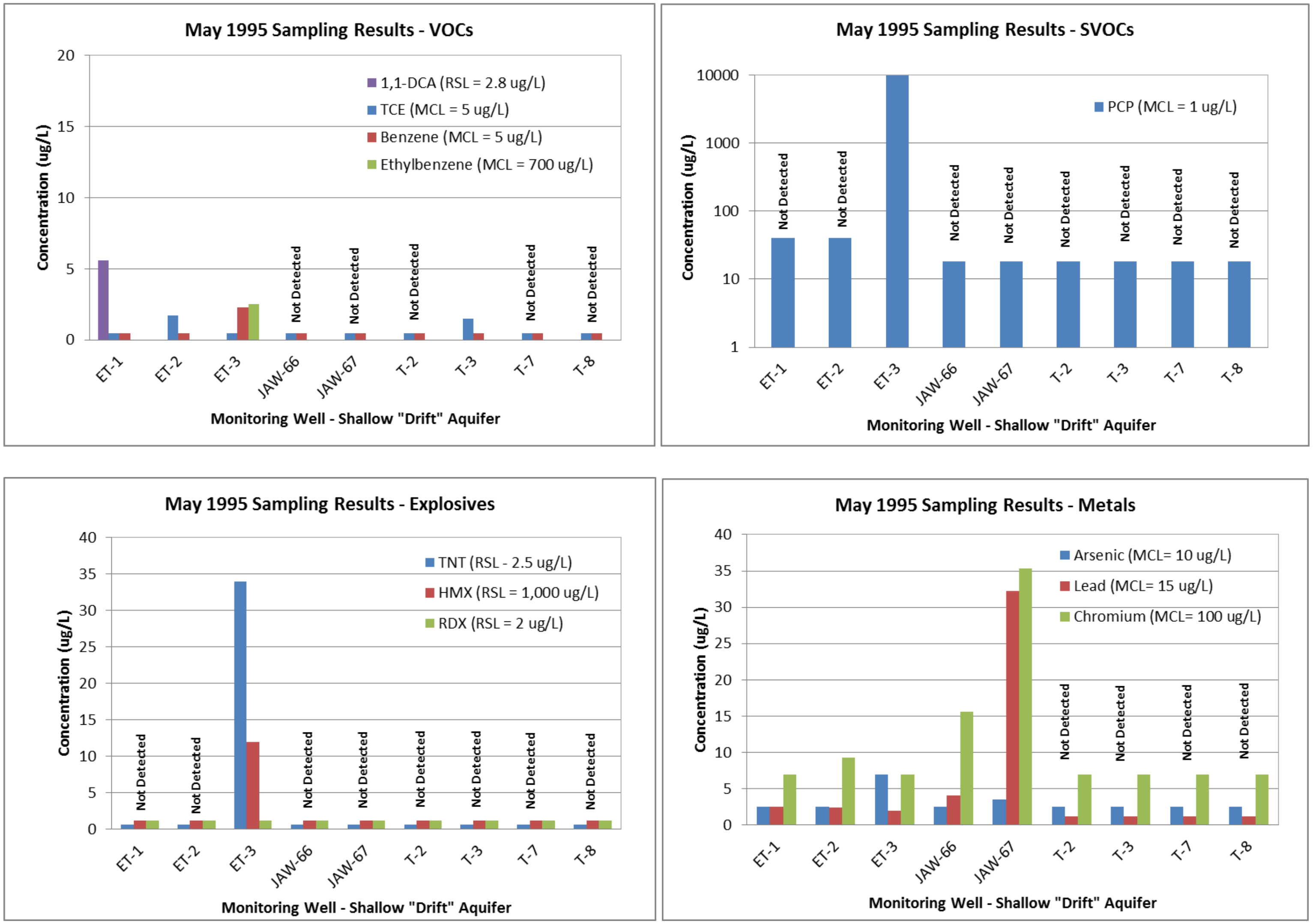


Figure IDA-10-9. IAAP-020 Inert Disposal Area Groundwater Snapshot in the Vicinity of ILF Trenches 1-5 Prior to Capping

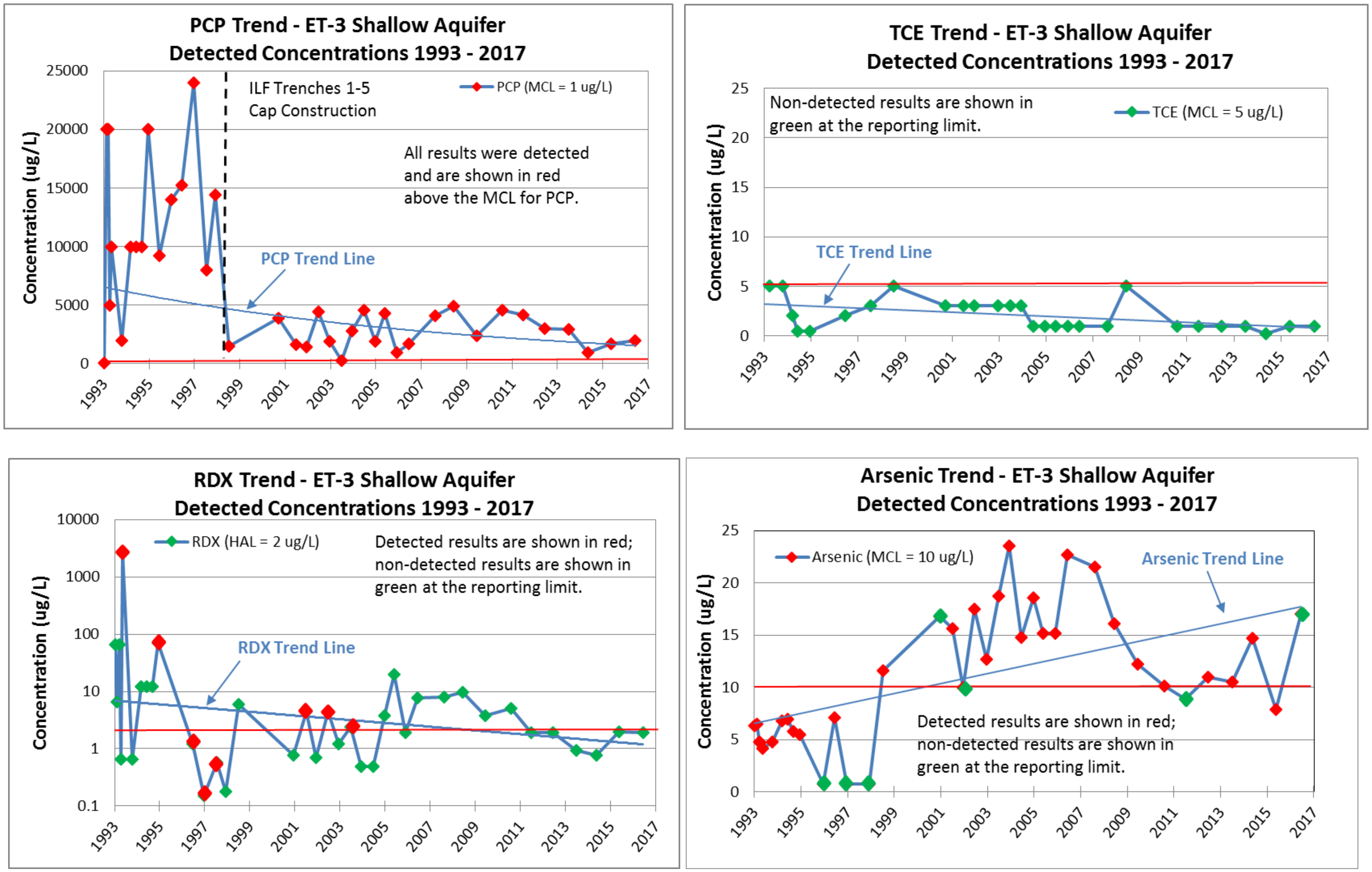
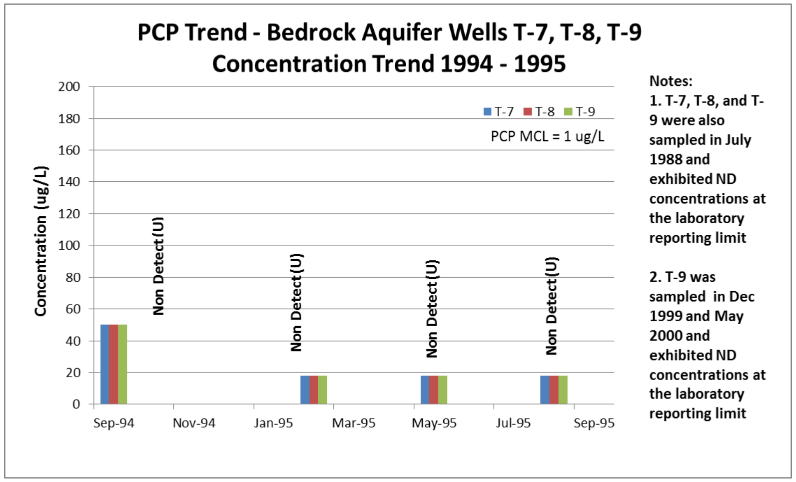
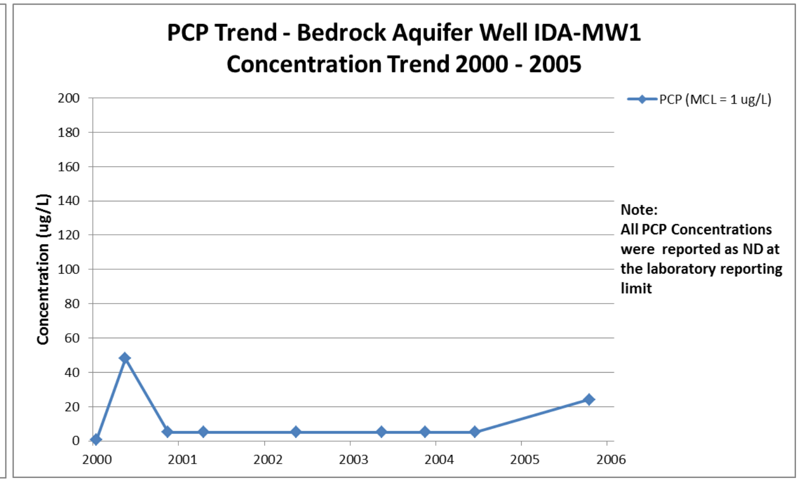


Figure IDA-10-10. IAAP-020 Inert Disposal Area Trend Charts for Selected Contaminants for Well ET-3 at ILF Trenches 1-5





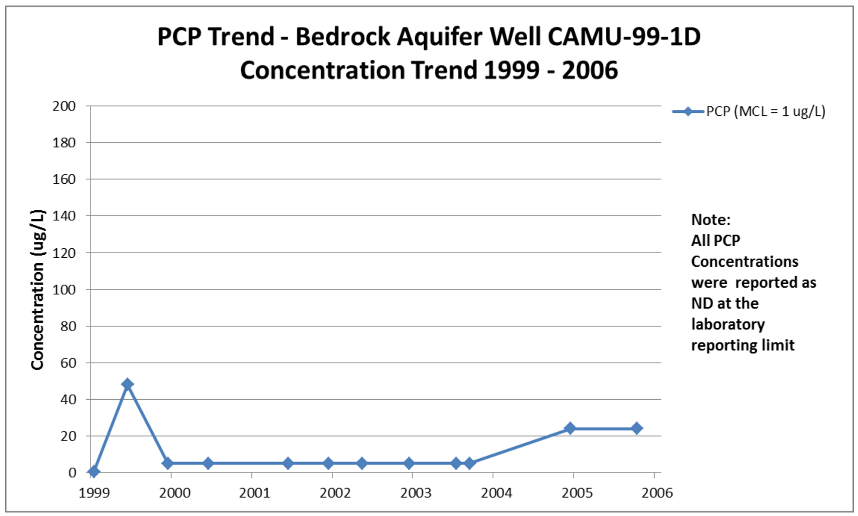


Figure IDA-10-11. IAAP-020 Inert Disposal Area Trend Charts for PCP in Bedrock Wells Around RCRA Ash Disposal Cell

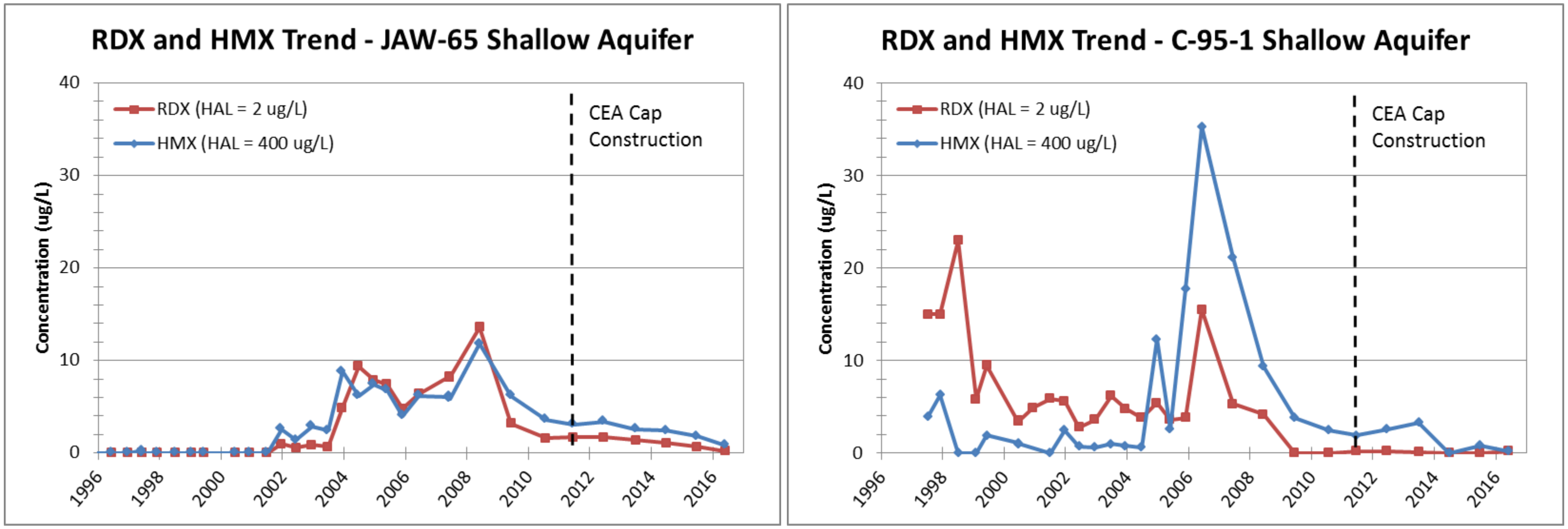


Figure IDA-10-12. IAAP-020 Inert Disposal Area Trend Charts for RDX and HMX in Wells in the Vicinity of the CEA

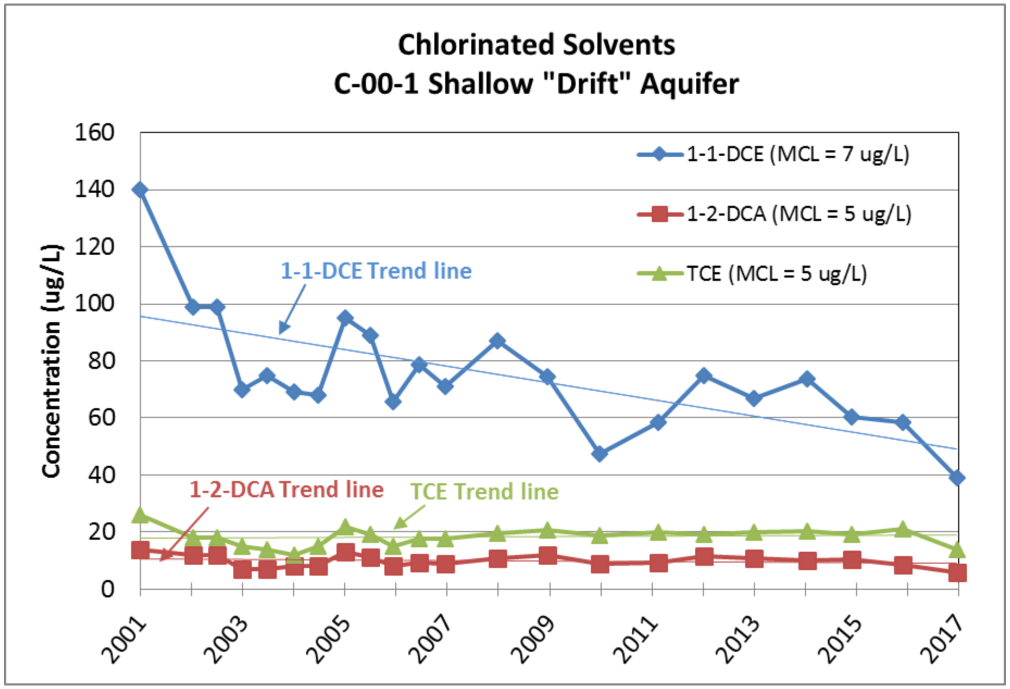


Figure IDA-10-13. IAAP-020 Inert Disposal Area Trend Chart for Selected Contaminants for Well C-00-1

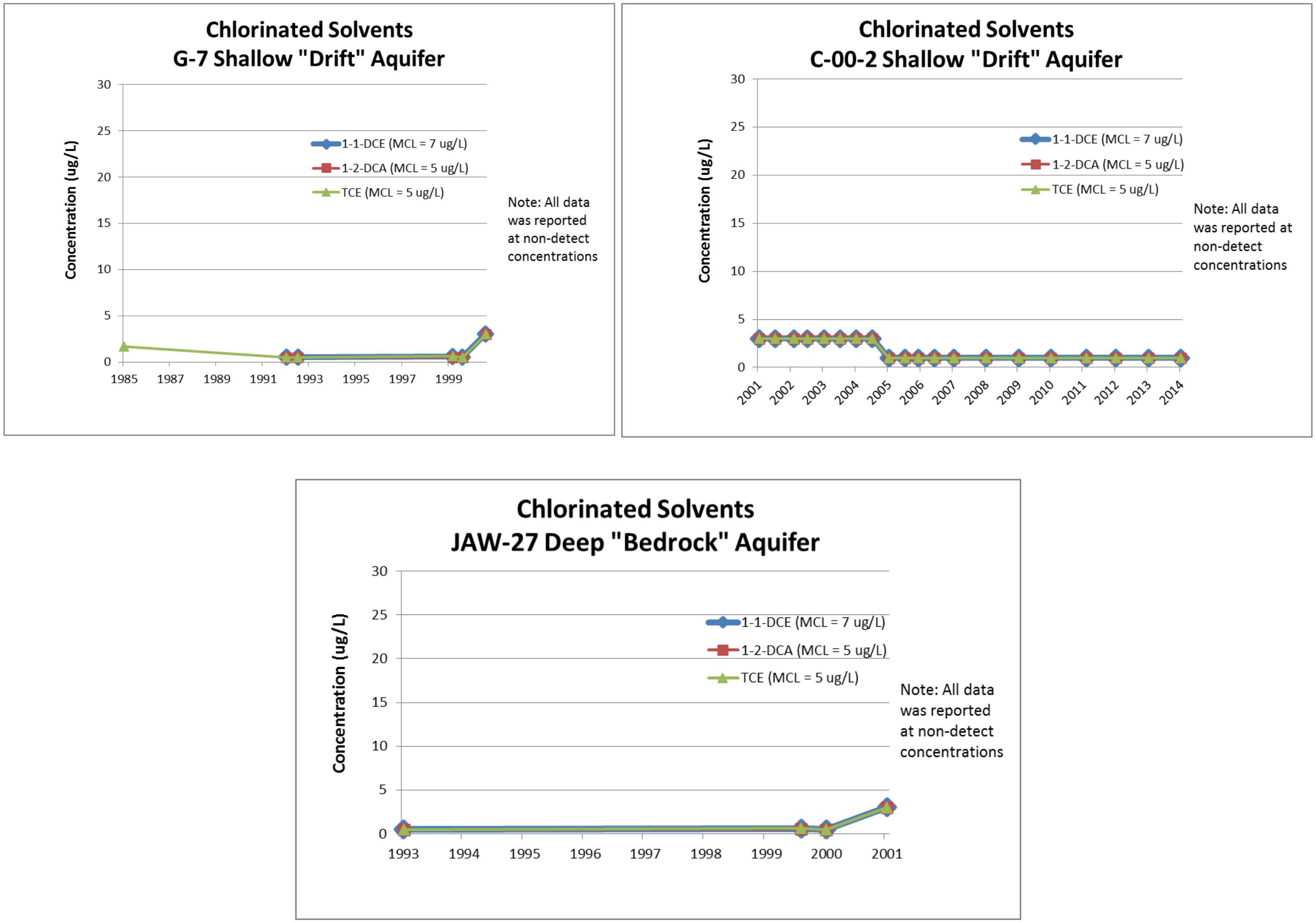


Figure IDA-10-14. IAAP-020 Inert Disposal Area Trend Charts for Selected Contaminants in the Vicinity of C-00-1

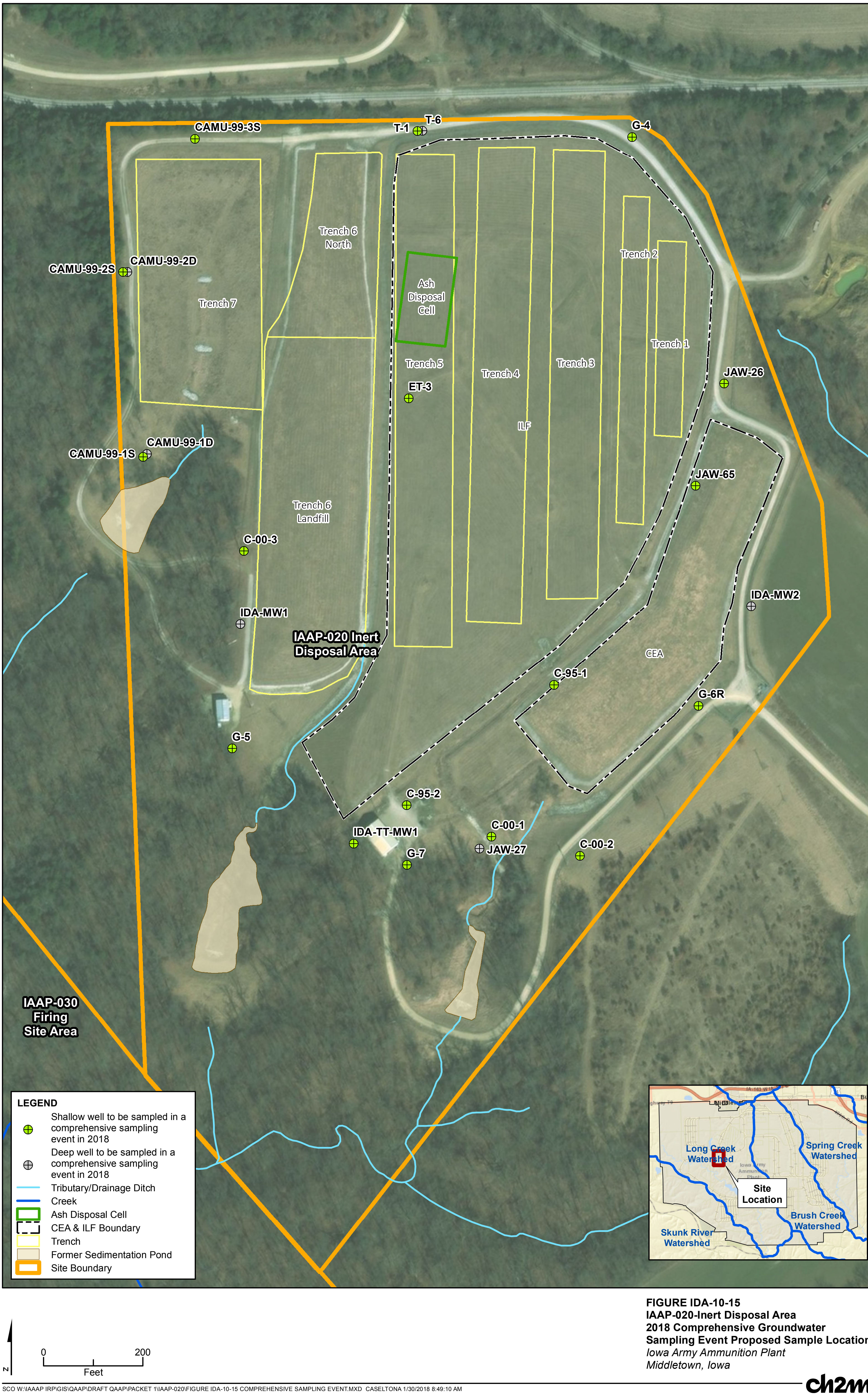
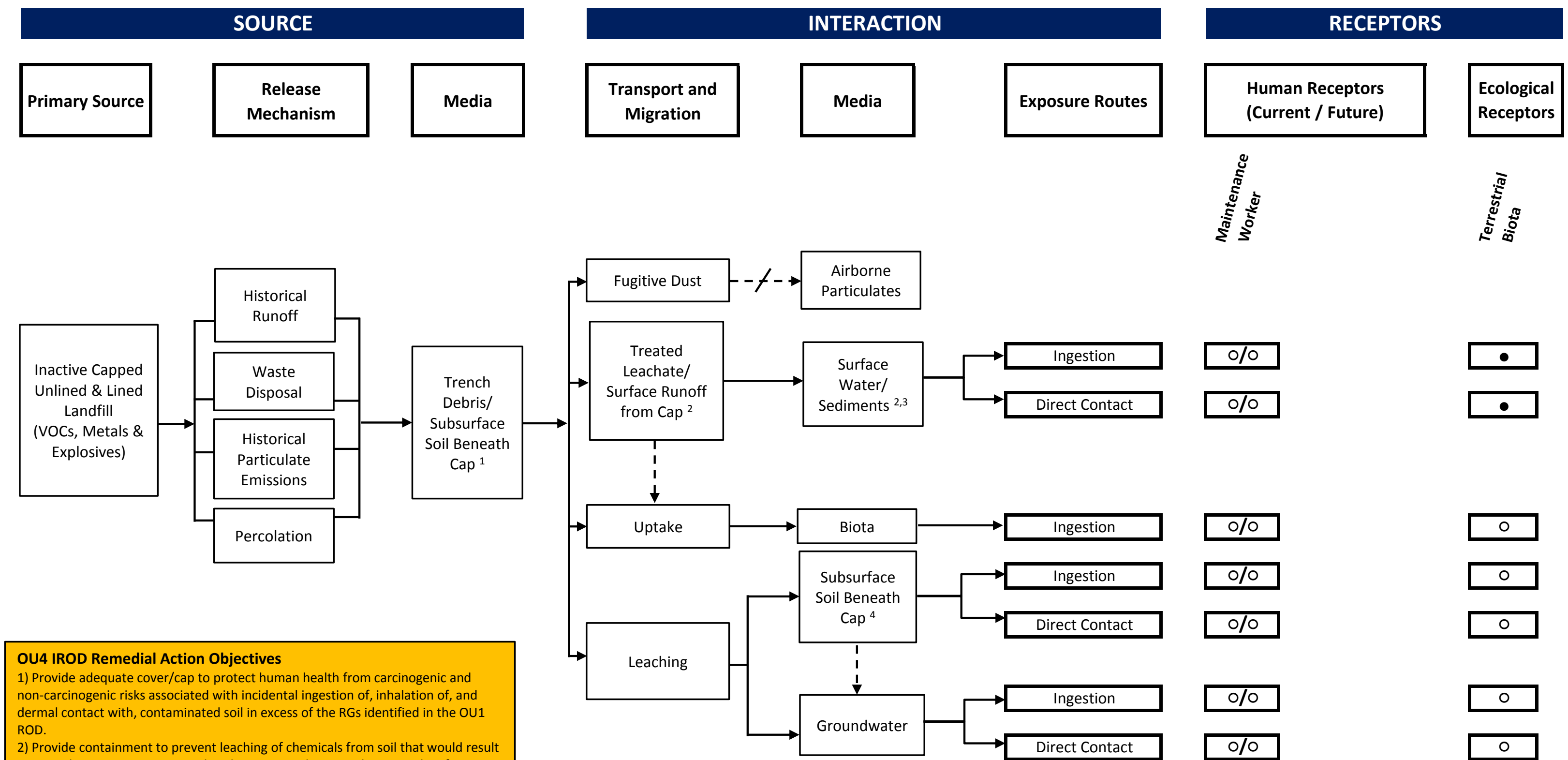


FIGURE IDA-10-15
IAAP-020-Inert Disposal Area
2018 Comprehensive Groundwater Sampling Event Proposed Sample Locations
Iowa Army Ammunition Plant
Middletown, Iowa

SCO W:\IAAAP IRP\GIS\QAAP\DRAFT QAAP\PACKET 1\IAAP-020\FIGURE IDA-10-15 COMPREHENSIVE SAMPLING EVENT.MXD CASELTONA 1/30/2018 8:49:10 AM

Figure IDA-10-16. IAAP-020/020G Inert Disposal Area Conceptual Exposure Model



OU4 IROD Remedial Action Objectives

1) Provide adequate cover/cap to protect human health from carcinogenic and non-carcinogenic risks associated with incidental ingestion of, inhalation of, and dermal contact with, contaminated soil in excess of the RGs identified in the OU1 ROD.
2) Provide containment to prevent leaching of chemicals from soil that would result in groundwater concentrations that do not meet the groundwater and surface water standards identified in the ARARs listed in OU1 RODs.
3) Provide a cover/cap to protect the environment from the COCs in soil that cause adverse ecological effects as described in the Baseline Ecological Risk Assessment.

OU4 Land Use Controls Performance Objectives

1) Prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities, and playgrounds;
2) Prevent intrusive activity into or near the cap system;
3) Maintain the integrity of cover/cap system;
4) Restrict property access to only authorized individuals for approved commercial, industrial, and remedy operation and maintenance purposes; and
5) Maintain the integrity of any current or future remedial or monitoring system.

[1] Near surface soil contamination at the Inert Disposal Area has been either removed or covered with a RCRA cap.

[2] Leachate collected from the landfill is treated (granular activated carbon) and discharged to a stream at levels (groundwater Health Advisory Level of 2 µg/L for RDX) that would result in insignificant exposures for human and ecological (terrestrial or aquatic) receptors. No direct contact exposure is expected during routine maintenance and repairs due to PPE requirements. Surface runoff from the cap is unlikely to contain contamination.

[3] Because LUCs are in place at the IDA in accordance with the September 2008 Interim Action ROD for OU4 (Tetra Tech 2008b), there are no complete exposure pathways for human receptors. Ecological exposure pathways are potentially complete at the former sedimentation ponds.

[4] The cap acts as a mitigating barrier to subsurface soil exposures (beneath cap) to humans and terrestrial biota. The SLERA will qualitatively discuss why ecological exposures are not expected to be significant.

LEGEND

→ Flow Chart Continues
-/→ Incomplete Pathway
--→ Insignificant Pathway
● Potentially Complete Pathway
○ Incomplete Pathway

Receptor	Potential Exposure Activity	Exposure Media/Pathway
Maintenance Worker	Routine grounds-keeping and maintenance/repairs on landfill leachate collection, treatment, and discharge system	None
Terrestrial Biota	Ecological activity at the former sedimentation ponds	Dry sediment and soil ingestion/direct contact

Inert Disposal Area Worksheet #11: Project/Data Quality Objectives

Project quality objectives (PQOs) define the type, quantity, and quality of data that are needed to answer specific environmental questions and support proper environmental decisions. The PQOs were developed during the work planning process.

Who Will Use the Data?

The USACE, IAAAP, Army Environmental Command (AEC), the CH2M HILL, Inc. (CH2M) Team, and other project stakeholders will use the data to support the environmental decisions, as outlined in IDA Worksheets #10, #17, and #18.

What Are the Project Screening Levels?

Current concentrations of explosives, VOCs, SVOCS, dioxins/furans, and metals in groundwater and historical concentrations of VOCs in discharge of groundwater to surface water, as appropriate, will be compared with the project risk screening levels (Installation-wide QAPP Appendix B). Screening levels are based on human health and ecological project objectives with the hierarchy of the specific objectives defined in IAAAP Worksheet #15. The derivation of screening levels is also described in the IAAAP Worksheet #15. Use of the screening levels to make decisions about the IDA site is described in Table IDA-11-1.

What Will the Data Be Used for?

As indicated in IDA Worksheet #14, groundwater samples from both the shallow and bedrock wells will be collected and analyzed for a broad spectrum of target analytes to evaluate the SRI objective, which is to provide a current snapshot of the groundwater quality throughout the IDA that would allow for further optimization of the groundwater monitoring program and a determination of any coverage gaps at the IDA.

What Types of Data Are needed and How “Good” Do the Data Need to Be in Order to Support the Environmental Decision?

The types of data that are needed for the SRI include definitive level data quality analyzed using a Department of Defense (DoD)-certified laboratory for the methods and analytes as described in IAAAP Worksheet #15. Definitive-quality data will be screened against the appropriate screening levels and used to support the decisions listed in Table IDA-11-1. The use of these data is not restricted unless there is a quality problem, such as a recurring quality control (QC) exceedance or a gross QC exceedance that would result in rejected data as defined in IAAAP Worksheet #36. The sampling design and rationale are presented in IDA Worksheet #17.

How Many Data Are Needed? Where, When, and How Should They Be Collected and Generated?

Tables provided in IAAAP Worksheet #14 describe the planned field investigation activities and schedule. The number and locations of samples needed, and the rationale for placement, are presented in IDA Worksheets #17 and #18.

Who Will Collect and Generate the Data?

The CH2M Team will collect the data on behalf of USACE and IAAAP. Samples for analysis will be sent under chain of custody to the TestAmerica Laboratory (Arvada, Colorado, and St. Louis, Missouri), which maintains required certifications to meet State of Iowa and DoD requirements, which include National Environmental Laboratory Accreditation Program certification and the DoD Environmental Laboratory Accreditation (ELAP) certification.

How Will the Data Be Reported and Archived?

The data will be reported in the SRI report according to procedures outlined in this UFP-QAPP. Hardcopy and/or electronic (such as database management system) data will be stored by the CH2M Team for 5 years after project completion. Project data and reports will be managed by the CH2M Team via proprietary database systems with final data deliverables submitted to the USACE via the Environmental Restoration Information System (ERIS). The final SRI report will become part of the Administrative Record file.

Table IDA-11-1. Data Quality Objectives (Site IAAP-020/020G)
UFP-QAPP RI, IAAAP, Middletown, Iowa

Step 1: **Problem Statement**	**Step 2:** **Decisions to be Made**	**Step 3:** **Input to the Decision**	**Step 4:** **Study Area Boundaries**	**Step 5:** **Decision Rules**	**Step 6:** **Acceptable Limits on Decision Error**	**Step 7:** **Optimize the Design**
Historical SI and RI investigations identified contamination (VOCs, SVOCs, metals, explosives, dioxins, and furans) in soil, surface water, sediment, and groundwater at the IDA. Removal actions were conducted at the Former Blue Sludge Lagoon, Former Burial Ground, Former Sludge Drying Beds/ Holding Pond to excavated contaminated materials. The ILF Trenches 1-5, CEA, and Trench 6 have been closed with RCRA covers, no further soil investigation is necessary. Similarly, the sediment contamination has been addressed via remedial actions at the sedimentation ponds associated with Trench 6, Trench 7, and the CEA. Currently, groundwater and surface water sampling is being conducted to ensure compliance with RCRA post-closure care and CERCLA IROD groundwater monitoring requirements. However, the monitoring network under the current LTM program consists of sampling 13 wells and a surface water location for selected analytes plus 3 wells for TOC and TOX. A comprehensive groundwater sampling event for all 23 existing wells (17 shallow and 6 bedrock wells) is necessary to provide a current snapshot of contaminant conditions in the shallow and deep aquifers in order to determine if there is need for any additional wells to evaluate nature and extent of contamination	When evaluating contamination in groundwater and discharge of groundwater to surface water, the following decisions will need to be made: 1. What quantity and location of samples are required to adequately evaluate shallow “drift” and “bedrock” aquifer contamination? 2. Are concentrations in groundwater above screening levels? Do site-related chemicals in groundwater pose potential unacceptable risk to human health and the environment? 3. Is the extent of the PCP and chlorinated solvents plumes defined for the RI? 4. If additional wells may be required, do site features and topography allow for the installation?	Elements to be considered in the decisions include the following: 1. Information and data contained in the SRI, previous investigations, and annual RCRA groundwater monitoring reports for Trench 5. 2. Existing historical records concerning onsite use and releases. 3. The site-specific CSM, such as topography, geology and hydrogeology, nature and extent of contamination, current and historical surface water drainage features, location of caps and historical construction activities, and groundwater flow direction. 4. Site improvements or development history that has occurred after releases or sampling. 5. Field observations and measurements from sampling activities. 6. Depth to groundwater measurements and groundwater gradient. 7. Sample locations and depths. 8. Existing and newly collected RI analytical data.	**Spatial Boundaries**: Sample 23 existing wells at the IDA.	***Decision 1—Location of Samples*** The location of the groundwater samples is based on the locations of the existing monitoring wells that have been sampled at various points in time during the LTM monitoring program, which were installed based on existing records of site use and releases, topography, vegetation, and drainage features. Analytical groundwater results will be compared to the screening levels to evaluate if the PCP and chlorinated solvents plumes have been adequately delineated to evaluate lateral and vertical extent, assess potential risk, complete the RI, and develop an FS. If the nature and extent of the two plumes is not adequately delineated to complete the RI, then the stakeholders will be engaged to evaluate whether further investigation is warranted. ***Decision 2—Evaluate Potential Risk*** If concentrations in groundwater are greater than applicable screening levels during this investigation, then these chemicals will be incorporated into the baseline risk assessment, if applicable, and a FS will be recommended. As part of the FS, an alternative will include merging the CERCLA and RCRA groundwater monitoring programs for post-closure monitoring of the landfill under a single regulatory body.	Judgmental sampling design was used to select sample locations based on the review of available data to evaluate groundwater concentrations compared to screening levels. Laboratory analyses will be conducted in accordance with this UFP-QAPP. Analytical chemical data will meet quality expectations for PARCCS, as defined by this UFP-QAPP. The analytical methods will provide the lowest available detection limits (DLs) (DL/limit of detection [LOD]/limit of quantitation [LOQ]) that will allow for the data to be compared to screening levels summarized in Installation-wide QAPP Appendix B and meet risk assessment objectives. Collection and interpretation of field measurements (e.g., groundwater sample depth, water quality parameters, etc.) will be conducted in accordance with standard industry practice and as specified in this UFP-QAPP.	To optimize the design, available site-specific data will be reviewed to determine the appropriate quantity and location of samples to be collected. The proposed sample design to address the problem statements is summarized below. 1. Twenty-three (23) existing monitoring wells (17 shallow and 6 bedrock) will be sampled using low-flow techniques in accordance with Standard Operating Procedures (SOPs) in Appendix A of the Installation-wide QAPP. One round of groundwater sampling will be conducted. Refer to IDA Worksheet #17 for design and rationale. 2. During the groundwater sampling events, water quality parameters (turbidity, dissolved oxygen, oxidation-reduction potential, specific conductance, temperature, and pH) will be measured to assess subsurface conditions.

See Acronyms and Abbreviations for abbreviations used in this table.

Inert Disposal Area Worksheet #14: Project Tasks

The RI at the IDA will consist of the following:

- Mobilization
- Monitoring well development and sampling
- Surveying
- Decontamination
- Demobilization
- Waste management
- Laboratory analysis and data management
- Baseline risk assessment
- Reporting and ERIS

Mobilization

See IAAAP Worksheet #14.

Monitoring Well Development and Sampling

Groundwater samples will be collected from 23 existing monitoring wells (17 shallow and 6 bedrock) as indicated in Table IDA-14-1. The screened intervals are shown in parentheses in feet bgs. The location of the wells is shown in IDA-10-15. Prior to well development and sampling, each well will be inspected to ensure the well's integrity and suitability for sampling.

Table IDA-14-1. IDA Existing Wells and Screened Intervals (Site IAAP-020/020G)
UFP-QAPP RI, IAAAP, Middletown, Iowa

Shallow "Drift" Aquifer Wells	"Bedrock" Aquifer Wells
C-00-1 (12.35 – 22.35)	CAMU-99-1D (135.5 – 145.5)*
C-00-2 (18.85 – 28.85)	CAMU-99-2D (145.5 – 155.5)*
C-00-3 (31.75 – 41.75)	IDA-MW1 (138.0 – 148.0)*
C-95-1 (6.5 – 16.0)	IDA-MW2 (102.0 – 112.0)*
C-95-2 (17.5 – 27.0)	JAW-27 (101.0 – 116.0)
CAMU-99-1S (20 – 29.5)*	T-06 (118.5 – 128.5)
CAMU-99-2S (20.0 – 30.0)*	
CAMU-99-3S (20.0 – 30.0)*	
ET-3 (15.0 – 30.0)	
G-4 (16.0 – 26.0)*	
G-5 (40.0 – 50.0)	
G-6R (not recorded)	
G-7 (32.0 – 42.0)	
IDA-TT-MW1 (35.0 – 45.0)	
JAW-26 (12.5 – 22.5)	
JAW-65 (19.0 – 24.0)	
T-01 (25.0 – 35.0)	

* Well is currently not sampled as part of the LTM program
See Acronyms and Abbreviations for abbreviations used in this table.

Well development will be conducted, as necessary, in accordance with SOP-01. Well development for the 15 wells in the current LTM program may not be needed as these wells are actively sampled. Well development will be required for 8 wells that were historically eliminated from the LTM program (shallow "drift" aquifer wells CAMU-99-1S, CAMU-99-2S, CAMU-99-3S, and G-4; and deep "bedrock" aquifer wells CAMU-99-1D, CAMU-99-2D, IDA-MW1, and IDA-MW2) and have not been sampled since the mid-2000s. Well development will be continued until a minimum of three well volumes is removed and the well water parameters have stabilized, as specified in SOP-01.

Groundwater sampling will be completed in accordance with SOP-14 no sooner than 48 hours after development. Monitoring well groundwater samples will be collected from the wells using low-flow sampling methods. Analytical parameters are listed on IDA Worksheet #18. Sample handling procedures will follow SOP-09 and SOP-10. Field work will be documented in accordance with SOP-07. If a groundwater sample cannot be collected following the SOP methods, the field team leader or designee will discuss the path forward with the CH2M Team's project manager.

Surveying

See IAAAP Worksheet #14.

Decontamination

See IAAAP Worksheet #14.

Demobilization

See IAAAP Worksheet #14.

Waste Management

See IAAAP Worksheet #14.

Laboratory Analysis and Data Management

Laboratory Analysis

TestAmerica in Arvada, Colorado, is the primary laboratory and will analyze the groundwater and surface water samples for designated parameters, with the exception of the metals analysis, which will be subcontracted to their St. Louis, Missouri, laboratory. TestAmerica holds a current DoD ELAP certification for the required methods and analytes.

Data Management

See IAAAP Worksheet #14.

Data Review

See IAAAP Worksheet #14.

Data Evaluation and Usability

See IAAAP Worksheet #14.

Baseline Risk Assessment

See IAAAP Worksheet #14. As discussed previously, there are no complete pathways for current and future human (i.e. maintenance worker) receptors at the IDA since the landfill is covered by caps in accordance with the Action Memorandum for the Inert Landfill or the 2008 OU4 IROD that are routinely maintained and land use controls have been implemented in accordance with the 2008 OU4 IROD. However, there are potentially complete exposure pathways for ecological receptors from contact with the former sedimentation ponds. Existing sediment/soil data will be used in a SLERA to evaluate the potential for ecological risk to terrestrial receptors. In addition, existing surface water data will only be evaluated qualitatively; permanent water bodies no longer exist as engineering controls were implemented in 2011 to ensure that the ponds do not maintain standing water by drilling drain holes in each of the standpipes in the sediment ponds. The CEM included in this UFP-QAPP is preliminary and was developed based on the current understanding of site conditions. However, the CEM will be refined, as needed, as additional site-specific information is obtained. A revised CEM will be provided for review within an HHRA interim deliverable to be provided prior to completion of the SRI. Unrestricted Land Use will also be evaluated in the risk assessment to assess baseline conditions and to assist in the evaluation in the FS if warranted.

Reporting and ERIS

See IAAAP Worksheet #14.

Inert Disposal Area Worksheet #17: Sampling Design and Rationale

This worksheet describes the design and rationale for the RI activities.

Investigation Design and Rationale

The following subsections describe the proposed groundwater samples to further characterize the site. Results from the proposed sampling will be used to determine if there is a need for any additional wells to delineate the lateral and vertical extent of contamination. Groundwater contaminant trends will be updated, as necessary, to support any additional proposed actions.

Rationale for Numbers and Locations of Samples

The IDA has had historical detections of VOCs, SVOCs, explosives, and metals in groundwater. The Ash Disposal Cell in Trench 5 has been under post-closure care RCRA groundwater monitoring since 1994 and a subset of those wells is required to be monitored in accordance with the OU4 IROD. In accordance with the RCRA/CERCLA LTM groundwater monitoring programs, 15 monitoring wells are sampled annually and each well is sampled for a specific suite of analytical parameters. Eight existing wells have been eliminated from sampling during the LTM program. Biased groundwater samples will be collected as follows:

- A single comprehensive round of groundwater samples will be collected from all site wells to evaluate the lateral and vertical distribution of contamination based on a single snapshot in time. This comprehensive sampling has not been conducted in over 10 years.
- Groundwater samples will be collected from 17 shallow "drift" aquifer wells (CAMU-99-1S, CAMU-99-2S, CAMU-99-3S, C-00-1, C-00-2, C-00-3, C-95-1, C-95-2, ET-3, G-4, G-5, G-6R, G-7, IDA-TT-MW1, JAW-26, JAW-65, and T-01). The shallow "drift" aquifer wells are screened at varying intervals as shown in Table IDA-14-1.
- Groundwater samples will be collected from 6 "bedrock" aquifer wells (CAMU-99-1D, CAMU-99-2D, IDA-MW1, IDA-MW2, JAW-27, and T-06). The deep "bedrock" aquifer wells are screened at varying intervals ranging as shown in Table IDA-14-1.
- Analytical parameters for groundwater samples from the shallow "drift" and "bedrock aquifer wells will include the full suite parameters indicated in IDA Worksheet #18 in order to provide current information on the distribution of contamination in both the shallow and deeper aquifers and confirm the extent of vertical migration of contaminant to the bedrock aquifer.
- MNA parameters will also be analyzed for samples from wells ET-3 and C-001 in order to evaluate the effectiveness of natural attenuation in groundwater where PCP and chlorinated solvents have exhibited concentrations above MCLs.

In addition, due to the presence of PCP in shallow well ET-3, well ET-3 will be sampled for dioxins/furans due to the potential degradation products associated with PCP. If dioxins/furans are determined to be present in ET-3, then shallow well C-00-3 and bedrock well IDA-MW1 will also be sampled for dioxins/furans.

Inert Disposal Area Worksheet #18: Sampling Locations and Methods

The following table IDA-18-1 summarizes the sampling matrix, number of samples to be collected, analytical parameters, and the sampling rationale described in IDA Worksheet #17 (Sampling Design and Rationale).

Table 18-1. Sample Locations and Sampling SOP Requirements (IAAP-020/020G)
UFP-QAPP RI, IAAAP, Middletown, Iowa

Sampling Location	Matrix	Depth	Analytical Group	Conc. Level	Estimated Number of Samples (Identify FDs)[a]	Sampling SOP Reference[b]	Rationale for Sampling Location
C-00-1, C-00-2, C-00-3, C-95-1, C-95-2, CAMU-99-1S, CAMU-99-2S, CAMU-99-3S, ET-3, G-4, G-5, G-6R, G-7, IDA-TT-MW1, JAW-26, JAW-65, T-01	GW	Shallow	Explosives, Metals, VOCs, SVOCs [d]	Low	17 samples;	SOP-01, SOP-04, SOP-06, SOP-07, SOP-08, SOP-09, SOP-10, SOP-11, SOP-14, SOP-16, SOP-22	Biased locations from all existing wells to refine CSM.
CAMU-99-1D, CAMU-99-2D, IDA-MW1, IDA-MW2, JAW-27, T-06	GW	Bedrock	Explosives, Metals, VOCs, SVOCs [d]	Low	6 samples;	SOP-01, SOP-04, SOP-06, SOP-07, SOP-08, SOP-09, SOP-10, SOP-11, SOP-14, SOP-16, SOP-22	Biased locations from all existing wells to refine CSM.
ET-3, C-00-3[e], IDA-MW1[e]	GW	Shallow/ Bedrock	Dioxins/ Furans [d]	Low	Up to 3 samples;	SOP-01, SOP-04, SOP-06, SOP-07, SOP-08, SOP-09, SOP-10, SOP-11, SOP-14, SOP-22	Biased locations at potential source area of PCP (ET-3) and potential closest downgradient locations in shallow aquifer (C-003) and deep aquifer (IDA-MW1)
ET-3 and C-00-1	GW	Shallow	MNA parameters [d]	Low	2 samples;	SOP-01, SOP-04, SOP-06, SOP-07, SOP-08, SOP-09, SOP-10, SOP-11, SOP-14, SOP-22	Biased locations based on historical sample locations; ET-3 and C-00-1 that have exhibited the presence of organic contamination.

See Acronyms and Abbreviations for abbreviations used in this table.

[a] At a minimum, one field duplicate (FD) sample will be collected for every 10 samples per field event, one matrix spike/matrix spike duplicate (MS/MSD) sample will be collected for every 20 samples per field event, one equipment blank will be collected for every 20 samples per field event, and one trip blank will be provided for each shipment when VOCs are collected.

[b] SOP-01, Monitoring Well Installation and Development
SOP-04, Equipment Decontamination Procedures
SOP-06, Field Water Quality Measurements and Calibration
SOP-07, Note Taking and Field Log Books
SOP-08, Site Reconnaissance, Preparation, and Restoration
SOP-09, Packing and Shipping of Environmental Samples
SOP-10, Sample Handling and Custody
SOP-11, Water Level Measurements
SOP-14, Groundwater Sampling
SOP-16, Water Sample Collection for Volatile Organic Compounds
SOP-22, Permits and Clearance

[c] Note that field parameters (oxidation-reduction potential, dissolved oxygen, ferrous iron, pH, temperature, specific conductivity, and turbidity) will be collected from each sampled well.

[d] Explosives (SW 846 Method 8330); Metals (SW 846 Method 6010B/7471A) – unfiltered samples; VOCs (SW 846 Method 8260B); SVOCs (SW 846 Method 8270D); MNA parameters include nitrate, nitrite, sulfate (SW846 Method 9056) and methane, ethane, ethene (RSK-175); Dioxins/Furans (SW8 846 Method 8290).

[e] Samples from C-003 and IDA-MW1 will only be analyzed for dioxins/furans if there are detections of dioxins/furans above screening levels in ET-3.

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