North Boundary Area Focused Feasibility Study Report

Former USG Taylor Way Plant Site

Public Review Draft

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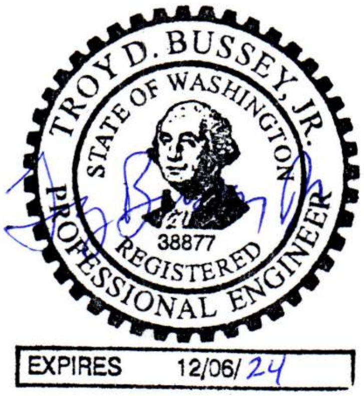
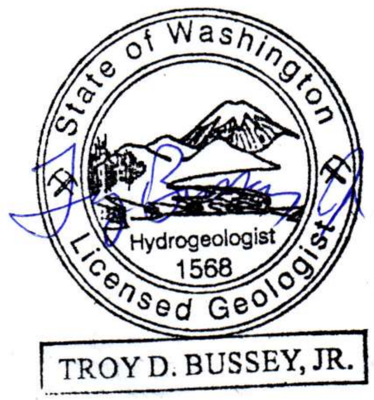
Professional Certification

This document was prepared under my direction. The information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that I was in responsible charge of the work performed for this document.





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Executive Summary

The purpose of the North Boundary Area (NBA) Feasibility Study (FS) is to develop and evaluate cleanup action alternatives (alternatives) for the NBA in accordance with Model Toxics Control Act (MTCA) regulations. Key components of the FS process include (1) establishing the constituents of concern (COCs) and cleanup standards, (2) assembling and evaluating alternatives using MTCA requirements, and (3) proposing a recommended alternative for stakeholder and public review. The purpose of this NBA FS Report (Report) is to document the NBA FS process and present the recommended NBA alternative. In order to expedite remediation of the NBA, the Washington State Department of Ecology (Ecology) determined that this Report would be incorporated under Agreed Order No. DE 3405 for the Former United States Gypsum Corporation (USG) Taylor Way Plant Site, and future remediation of NBA contamination would be incorporated into future administrative actions for implementation of the cleanup action at the Former USG Taylor Way Plant Site (Ecology 2021).

The NBA COCs are arsenic in soil and groundwater and lead in soil, consistent with the metal COCs for the adjacent USG property (CDM Smith 2021). The primary soil cleanup levels (CLs) are industrial soil CLs (i.e., 88 mg/kg for arsenic and 1,000 mg/kg for lead), although Alternative 4 utilizes unrestricted land use soil CLs (i.e., 20 mg/kg for arsenic and 250 mg/kg for lead) and Alternative 2 utilizes arsenic soil remediation levels (RLs; 400 mg/kg for chronic-based exposures and 1,060 mg/kg for acute-based exposures). The NBA groundwater CL for dissolved arsenic is 8 ug/L.

The four alternatives evaluated in this Report were:

- Alternative 1, which includes installing and maintaining a cap/cover, monitored natural attenuation (MNA), and institutional controls (ICs).
- Alternative 2, which includes soil excavation and off-site disposal to achieve statistical compliance with the arsenic RL for chronic-based exposures and the industrial soil CL for lead, installing and maintaining a cap/cover, MNA, and ICs.
- Alternative 3, which includes soil excavation and off-site disposal to achieve statistical compliance with the industrial soil CLs, MNA, and ICs.
- Alternative 4, which includes soil excavation and off-site disposal to achieve statistical compliance with the unrestricted land use soil CLs and MNA.

The four alternatives were evaluated relative to six of the seven MTCA requirements for remedy selection.[1] Based on this evaluation, the recommended cleanup action alternative is Alternative 3. Alternative 3 satisfies the four MTCA threshold requirements, uses permanent solutions to the maximum extent practicable, and achieves cleanup standards within a reasonable restoration time frame. Alternative 3 protects human health and the environment, removes substantial amounts of COC mass, employs reliable and proven technologies, can be implemented relatively quickly, and is cost-effective. Selection of Alternative 3 as the remedy is subject to Ecology approval after public review.

[1] The "consider public concerns" requirement was not evaluated because public comments have not yet been solicited, and will be evaluated after the public comment period is completed.

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List of Acronyms

Acronym	Explanation
Alternative	Cleanup Action Alternative
Arkema Property	Former Arkema Manufacturing Property
bgs	Below Ground Surface
CAO	Cleanup Action Objective
CAP	Cleanup Action Plan
CL	Cleanup Level
COC	Constituent of Concern
COPC	Constituent of Potential Concern
CSM	Conceptual Site Model
DDT	Dichloro-diphenyl-trichloroethane
DOF	Dalton, Olmsted, & Fuglevand, Inc.
Ecology	Washington State Department of Ecology
EMP	Electron Microprobe
Fibers	Rock Wool Mineral Fibers
FS	Feasibility Study
IA	Interim Action
ICs	Institutional Controls
MNA	Monitored Natural Attenuation
MTCA	Model Toxics Control Act
MW	Monitoring Well
NBA	North Boundary Area
PDI	Pre-Design Investigation
PIONEER	PIONEER Technologies Corporation
PMI	Port Maritime Industrial
Port	Port of Tacoma
POC	Point of Compliance
PSAPCA	Puget Sound Air Pollution Control Agency
Report	NBA Focused FS Report
RI	Remedial Investigation
RL	Remediation Level

Acronym	Explanation
Site ID	Site Identification Number (Sample Location)
SL	Screening Level
TCLP	Toxicity Characteristic Leaching Procedure
USG	United States Gypsum Corporation
USG FS report	Public Review Draft FS report for the USG Property
USG Property	Former USG Property
WAC	Washington Administrative Code
XRF	X-ray Fluorescence

SECTION 1: INTRODUCTION

1.1 Purpose

The purpose of the North Boundary Area (NBA) Focused Feasibility Study (FS) is to develop and evaluate cleanup action alternatives (alternatives) to address arsenic and lead contamination within the NBA in accordance with Model Toxics Control Act (MTCA) regulations. Key components of the FS process include (1) establishing the cleanup action objectives (CAOs), constituents of concern (COCs), and cleanup standards, (2) screening remedial technologies to determine the most promising technologies, (3) assembling the retained technologies into alternatives, (4) evaluating the assembled alternatives using MTCA requirements, and (5) proposing a recommended alternative for stakeholder and public review. The purpose of this NBA Focused FS Report (Report) is to document the NBA FS process and present the recommended alternative for the NBA. This Report was prepared in accordance with MTCA regulations in Washington Administrative Code (WAC) 173-340-350. As discussed further in Section 2.4, this Report was prepared under Agreed Order No. DE 3405 requirements for the Former United States Gypsum Corporation (USG) Taylor Way Plant Site.

1.2 Definition of Terms and Boundaries

Consistent with Port of Tacoma (Port) practices, all references to direction (i.e., north, south, east, and west) in this Report are in relation to "site north," which is parallel to the Hylebos Waterway shoreline (see Figure 1-1). "Site north" is approximately 45 degrees west (counterclockwise) from true north. Both "site north" and true north are shown on the figures for this Report.

To facilitate clear communication about boundaries and locations, the following terms are defined as follows for the purposes of this Report:

- NBA: The NBA is located on the former Arkema[2] Manufacturing Property (Arkema Property) between the Arkema Property salt pads and the former mineral fiber manufacturing facility on the adjacent former USG[3] Property (USG Property). The NBA boundary defined on Figure 2 of the Public Review Draft FS report for the USG Property (USG FS report; CDM Smith 2021) was used as the conceptual and functional boundary in this Report. The conceptual and functional NBA boundary is shown on Figure 1-1.[4]
- USG Property: The USG Property is defined as the roughly L-shaped 9.4-acre parcel (tax parcel number 0321351006) located at 2301 Taylor Way in Tacoma, Washington. The USG Property was occupied by a former mineral fiber manufacturing facility that was operated by USG, its

[2] Arkema is used in this Report to represent all companies that operated the former manufacturing facility, including Tacoma Electrochemical Company, Pennsylvania Salt Manufacturing Company of Washington, Pennwalt Corporation, Atochem Inc., Elf Atochem North America, and Atofina Inc. (Malcolm Pirnie 2006).

[3] USG is used in this Report to represent all companies that operated the former manufacturing facility, including Pacific Carbide Corporation, Mineral Fiber Producing Company, Feltrock Insulation Manufacturing Company, USG (including subsidiaries USG Acoustical Products Company and USG Interiors), and Thermafiber LLC (CDM Smith 2016).

[4] The northern NBA boundary is the property boundary between the USG Property and the Arkema Property. The western NBA boundary is the Arkema Property boundary. The southern NBA boundary is the northern edge of the former salt pads.

predecessors, and its successor (i.e., Thermafiber) from the early 1940s through 2002. This Port-owned property is bounded to the east by the Hylebos Waterway and to the west by Taylor Way (see Figure 1-1). The property is currently occupied by Port tenant Carlile Transportation Systems Inc. The southern portion of the USG Property adjoining the NBA includes previously completed remedial excavations referred to as the MW9, B13, and B23 excavations (see Figure 1-1). In addition, further excavations adjoining the NBA are proposed in a portion of the USG Property called the South Corner Area (see Figure 1-1) as part of the recommended alternative for the USG Property (CDM Smith 2021).

- Arkema Property: The Arkema Property is defined as an approximately 45-acre portion of a 64.8-acre parcel (tax parcel number 0321351053) located at 2901 Taylor Way and a 3.2-acre parcel (tax parcel number 0321362056) located at 2920 Taylor Way (see Figure 1-1). The Arkema Property was occupied by a former chemical manufacturing facility that was operated by Arkema and its predecessors from 1927 to 1997. The majority of the Arkema Property is part of the Former Arkema Manufacturing Site, which is being addressed pursuant to Agreed Order No. DE 5668. This Port-owned property is currently vacant and awaiting redevelopment.
- Former USG Taylor Way Plant Site: The exact boundary of the Former USG Taylor Way Plant Site has not been formally defined yet. The Former USG Taylor Way Plant Site is defined in the USG FS report as "a property herein referred to as the Taylor Way Property and, to the extent that contaminants originating from the Taylor Way Property are causing an impact, the adjacent former Murray Pacific Property to the north and an area to the south on 2901 Taylor Way" (CDM Smith 2021). "The area to the south on 2901 Taylor Way" is the NBA, including the area where USG waste extended at least five feet into the NBA (AGI Technologies 2000). The Former USG Taylor Way Plant Site is being addressed pursuant to Agreed Order No. DE 3405.

Since the exact boundary of the Former USG Taylor Way Plant Site has not been formally defined yet, the aforementioned definitions for the NBA, USG Property, and Arkema Property are the primary terms used in this Report to describe respective areas.

1.3 Report Organization

The remainder of this Document is organized as follows:

- Section 2: Background Information
- Section 3: Cleanup Action Objectives, Constituents of Concern, and Cleanup Standards
- Section 4: Identification and Screening of Remedial Technologies
- Section 5: Development of the Cleanup Action Alternatives
- Section 6: Evaluation of the Cleanup Action Alternatives
- Section 7: The Recommended Cleanup Action Alternative
- Section 8: References

SECTION 2: BACKGROUND INFORMATION

A summary of the background information most pertinent to this Report is presented in this section to provide context for the primary FS content (Section 3 through 7). The Arkema Property information presented in this section is based on the Remedial Investigation (RI) Report for the Arkema Property (Dalton, Olmsted, & Fuglevand, Inc. [DOF] 2013) and/or the FS Data Gap Investigation Report for the Arkema Property (PIONEER Technologies Corporation [PIONEER] 2019), unless otherwise noted. The USG Property information presented in this section is based on the Supplemental RI Report for the USG Property (CDM Smith 2016), unless otherwise noted.

2.1 Overview of Environmental Setting

The NBA is located within the tideflats of the Puyallup River delta. In general, the pre-development tideflats consisted of alternating layers of lower permeability silt/clay deposits and sandy deposits. Sediment dredged from Commencement Bay and its tributaries as well as other fill material were used to create developable land during the industrial development of the tideflats. This anthropogenic fill unit, which consists primarily of dredge sand and imported fill, was placed prior to 1927. Some additional fill was added to formerly low-lying areas within the NBA between 1927 and 1986. The most recent fill events were the placements of a soil cap/cover over Waggoner's Wallow and a bark sludge cover across most of the NBA between 1986 and 1990 (see Sections 2.3.2 and 2.5). The post-fill topography of the NBA is relatively flat, with the exceptions of the shorelines sloping to the Hylebos Waterway, a soil berm placed along the northern end of the NBA after 1990, existing soil stockpiles generated in 2003 during the Arkema Salt Pad Bank Cleanup and Salt Marsh Relocation project (DOF 2011), and a low lying area at the western NBA boundary. Land use in the NBA, the Arkema Property, and the USG Property has been industrial and is expected to remain industrial (see also Section 2.8).

The Arkema Property and USG Property are located in Western Washington, which is typified by relatively mild temperatures and a marine-influenced climate (Western Regional Climate Center 2016). The average annual precipitation for Tacoma is approximately 40 inches, with most precipitation falling between October and April (Western Regional Climate Center 2016).

2.2 Overview of Hydrogeology

The relevant hydrostratigraphic units at the Arkema Property (including the NBA), from shallowest to deepest, correspond to a specific lithologic unit and include the following:

- Surface Aquifer: The Surface Aquifer is the saturated portion of the fill unit. The thickness of the Surface Aquifer is approximately ten to 15 feet. Although this unit was called Upper Aquifer in past NBA-related documents, the term Surface Aquifer is used to be consistent with Former USG Taylor Way Plant Site documents.
- First Aquitard: The First Aquitard is the upper silt unit that consists of former tideflat sediments. The First Aquitard is typically encountered at depths between approximately ten and 15 feet. With a few exceptions, the First Aquitard is consistently present, with a typical thickness of approximately five to ten feet.

- Second Aquifer: The Second Aquifer is the intermediate sand unit. The thickness of the Second Aquifer is approximately ten to 20 feet. Although this unit was called Intermediate Aquifer in past NBA-related documents, the term Second Aquifer is used to be consistent with Former USG Taylor Way Plant Site documents.
- Second Aquitard: The Second Aquitard is the lower silt unit. The thickness of the Second Aquitard is approximately five to 15 feet.
- Deep Aquifer: The Deep Aquifer is the lower sand unit. The thickness of the Deep Aquifer appears to be at least 20 feet thick.

Groundwater within the NBA flows towards the Hylebos Waterway. In general, groundwater in the Surface Aquifer flows northeast towards the Hylebos Waterway, while groundwater in the Second Aquifer and Deep Aquifer flow east towards the Hylebos Waterway during and near low tides (see Appendix A).[5,6] During the 2012 and 2017 monitoring events, the depth to groundwater in the five Surface Aquifer NBA MWs ranged from approximately 0.4 feet below ground surface (bgs) in 1B4-1 to 9.4 feet bgs in 3A3-1R (DOF 2013; PIONEER 2019). Surface Aquifer seasonal fluctuation in the adjacent South Corner Area on the USG Property ranges from approximately 1.8 feet bgs to 5 feet bgs (CDM Smith 2021). Similarly, the seasonal fluctuation between November 2018 and July 2019 in two Surface Aquifer MWs located near the former Penite Pits on the Arkema Property was approximately three feet.[7] Tidal influence on NBA groundwater increases with depth (i.e., the Deep Aquifer is significantly more tidally influenced than the Surface Aquifer) and proximity to the Hylebos Waterway (i.e., MWs closer to the shoreline are generally more tidally influenced that MWs located farther away). Flow reversals occur in the Deep Aquifer, and in the Second Aquifer to a certain extent, during high tides (see Appendix A).

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[5] Groundwater elevation contour figures for the Surface Aquifer (i.e., Figures 1 through 10 from PIONEER 2022) as well as the Second Aquifer (aka Intermediate Aquifer) and Deep Aquifer (i.e., Figures 3-13a through 3-14b from DOF 2013) are included in Appendix A.

[6] Monitoring well (MW) surveying and gauging activities were conducted in June 2022 to assess a previously reported groundwater mound at MW 1B4-1 during two 2012 groundwater monitoring (GWM) events, one 2014 GWM event, and one 2017 GWM event groundwater (PIONEER 2022). A groundwater mound was not present at 1B4-1 during the June 2022 MW gauging event. In PIONEER's opinion, the anomalously high groundwater elevations at 1B4-1 during the 2012, 2014, and 2017 GWM events are likely not representative of true groundwater conditions at that location based on (1) groundwater elevations in surrounding MWs, (2) the lack of a groundwater mound at 1B4-1 during the five previous NBA GWM events (Geomedia 1995; Boateng 2002) and the June 2022 gauging event, and (3) the lack of a logical hypothesis for why an actual groundwater mound would exist at 1B4-1. In PIONEER's opinion, the anomalous 2012, 2014, and 2017 groundwater elevations at 1B4-1 are likely due to some issue with the MW itself (e.g., poor MW construction, post-2002 MW damage). PIONEER recommends decommissioning 1B4-1 before any excavation activities are conducted, installing a replacement MW for 1B4-1 after all excavation backfill activities are completed, and conducting additional GWM events to confirm or refute the presence of a groundwater mound at 1B4-1.

[7] Based on November 2021 personal correspondence between Joel Massmann (KetaWaters) and Troy Bussey (PIONEER). Water level data was obtained every four hours between November 8, 2018 and July 30, 2019 from transducers installed in MWs 5D7-1R and 5E8-1.

2.3 Overview of Operational History

As the NBA lies between the locations of the former mineral fiber manufacturing facility on the USG Property and the former Arkema chemical manufacturing facility, brief overviews of USG operations and Arkema operations are provided below.

2.3.1 USG Operations

Rock wool mineral fiber (fiber) was manufactured on the USG Property by USG, its predecessors, and its successor (i.e., Thermafiber) from the early 1940s through 2002. Key historical manufacturing features within the former USG manufacturing area included the cupola room, production building, main smokestacks, baghouse, dry filter, pump room, and dry filter smokestacks. The approximate locations of the former USG manufacturing area and these key manufacturing features are shown on Figure 2-1. In general, fiber manufacturing consisted of heating feedstocks such as slag and basalt rock to a molten state in a cupola furnace and then cooling and fiberizing the molten material with air in the production building (TLI Systems 1996). Slag obtained from ASARCO's smelter in Ruston, Washington was used as a raw material for fiber manufacturing from at least 1946 until 1973 (TLI Systems 1996; PIONEER 2017). ASARCO slag-related wastes generated by USG included fibers, shot, slag fines, baghouse dust, and air emissions (TLI Systems 1996; CDM Smith 2016). These USG wastes contained elevated arsenic and lead concentrations from the ASARCO slag. As noted by CDM Smith, "arsenic and lead are typically the metals that drive cleanups at sites contaminated by ASARCO slag" (CDM Smith 2016).

The facts about arsenic- and lead-contaminated USG wastes that are most pertinent to the conceptual site model (CSM) and eventual remediation of the NBA include:

- "Temporary stockpiles of … waste material (mixture of shot, slag fines, baghouse dust, off-spec product, cupola bottoms) were located on mostly unpaved surfaces at the … southeastern side of the production building" (CDM Smith 2016). The approximate extent of waste stockpile areas based on a review of historical photographs is shown on Figure 2-2 (PIONEER 2017).
- USG used some of the aforementioned stockpiled waste as fill when it paved the area between the production building and the NBA in circa 1981 (PIONEER 2017; CDM Smith 2016).[8] "Shot and other waste products, some of which were derived from the ASARCO slag, had been used as fill throughout the material stockpile area and southeastern truck passageway to raise the grade" (CDM Smith 2016).
- A total of 12,320 tons of USG waste and arsenic- and lead-contaminated soil were removed during the excavations of the MW9, B13, and B23 areas (see Figure 2-2 and Section 2.5). These excavations occurred in the area between the production building and the NBA (e.g., where waste was used as fill in circa 1981), and the MW9 area excavation extended five feet into the NBA.
- USG emitted wastes from (1) the main smokestacks prior to 1970 (without any emission controls), (2) the main smokestacks subsequent to 1970 (with emission controls), and (3) the dry

[8] This area of stockpiled waste is referred to as the southeastern truck passageway in the CDM Smith Supplemental RI Report (CDM Smith 2016).

filter smokestacks subsequent to circa 1974 to 1978 (TLI Systems 1996; PIONEER 2017). Existing evidence confirms deposition of these airborne wastes within the NBA (PIONEER 2017).[9]

2.3.2 Arkema Operations

All of the manufacturing operations on the Arkema Property were conducted in the former Central Manufacturing Area, which is located to the south of the NBA and salt pads (see Figure 2-3). The potential arsenic sources associated with Arkema manufacturing operations are all located within the former Central Manufacturing Area, and consist of the former Penite Manufacturing Area, the former Penite Pits, the former Sandblasting Shed, and green-colored sand present on the ground in 1981 (see Figure 2-3). There are no known or suspected potential lead sources associated with Arkema manufacturing operations. The closest potential arsenic source (the former Penite Manufacturing Area) is approximately 1,000 feet south of the southern NBA boundary. The only historical Arkema features within or immediately adjacent to the NBA were (1) the former surface impoundment known as Waggoner's Wallow, (2) the salt pads, and (3) the bark sludge application area (see Figure 2-1). Waggoner's Wallow, the salt pads, and bark sludge are not sources of arsenic and lead contamination (PIONEER 2017).

Waggoner's Wallow was used for treatment and temporary storage of chlorine manufacturing wastes from the 1940s through 1986.[10] Chlorine manufacturing essentially consisted of adding electrical power to salt water in a reactor cell to produce chlorine gas (AWARE Corporation 1981; Malcolm Pirnie 2006). The chlorine manufacturing wastes were "waste sodium hypochlorite from the absorber tanks and off-gas from the chlorine process," which "were disposed of in Waggoner's Wallow for natural decomposition of brine and dissipation of residual chlorine, respectively” (Kennedy/Jenks/Chilton 1990). In summary, arsenic and lead were not associated with the raw materials used for chlorine manufacturing or the sodium hypochlorite or chlorine off-gas wastes generated by chlorine manufacturing (AWARE Corporation 1981; Malcolm Pirnie 2006). As a result, the historical use of Waggoner's Wallow is not a source for arsenic or lead contamination.

The salt pads (which were located immediately south of the NBA) were formerly used for temporary storage of sea salt. This sea salt was the primary feedstock for the production of chlorine, sodium hydroxide, sodium chlorate, and hydrochloric acid within the former Central Manufacturing Area (Malcolm Pirnie 2006). Any naturally occurring arsenic or lead in the sea salt was negligible because sea

[9] Amongst many other Puget Sound Air Pollution Control Agency (PSAPCA) notices of violation and civil penalties, USG received three PSAPCA civil penalties specifically related to "causing or allowing the discharge of particulate matter to become deposited upon the real property of others" between 1967 and 1975 alone. PSAPCA documentation also provides details about the deposition of USG particulate matter onto the NBA. For instance, a 1973 report from a PSAPCA inspector noted "Was called to the parking lot of Pennwalt, by Dennis Roths, to see fly wool falling on the lot and adjacent property. I took a picture of it, examined it, and took a sample of it. I then went back to the parking lot of U.S. Gypsum where the same conditions prevailed." Historical photographs provide further evidence that particulate matter from USG emissions was deposited on the NBA.

[10] The ditch portion of Waggoner's Wallow was expanded between 1955 and 1958 (as the size of the salt pads were expanded) and the pond portion of Waggoner's Wallow was added between 1970 and 1971 (PIONEER 2017).

salt consists almost entirely of sodium and chloride and it contains almost no arsenic or lead.[11] As a result, it has previously been concluded that there are "no known or suspected sources of contamination" associated with the salt pads or the sea salt stored on the salt pads (Malcolm Pirnie 2006).

To establish a vegetative cover, bark sludge was spread across a large portion of the NBA and adjacent areas on the Arkema Property in several phases between 1986 and 1990 (Boateng 1990; PIONEER 2017). Bark sludge was a mixture of wood (bark and other wood residues) from a wood processing operation and sludge excavated from the former surface impoundments (also known as former waste ponds) located south of the former Central Manufacturing Area (Boateng 1990; DOF 2013). The sludge in these former surface impoundments and the resulting bark sludge contained relatively low arsenic and lead concentrations (Boateng 1990; DOF 2013). The minimum, average, and maximum arsenic concentrations in the bark sludge were 4.0 mg/kg, 26 mg/kg, and 42 mg/kg, respectively, while the minimum, average, and maximum lead concentrations were 13 mg/kg, 28 mg/kg, and 36 mg/kg, respectively (Boateng 1990).

Prior to the application of bark sludge, some areas in the northern portion of the NBA were low-lying areas. A particularly pertinent low-lying area was located adjacent to where USG stockpiled wastes and used waste as fill material (PIONEER 2017). Following heavy rainfall, ponded water was sometimes present in these formerly low-lying areas, likely as a result of stormwater runoff from the USG Property and the Waggoner’s Wallow/salt pads area. Since the chlorine manufacturing wastes discharged to Waggoner's Wallow and the source salt stored on the salt pads contained negligible amounts of arsenic and lead, stormwater runoff from the Waggoner’s Wallow/salt pads area would not have contained elevated arsenic and lead concentrations.

2.4 Overview of Regulatory Setting

The Washington State Department of Ecology (Ecology) determined that remediation of NBA contamination “shall be incorporated into the FS and draft Cleanup Action Plan (CAP) required under Agreed Order No. DE 3405 (AO 3405) for the USG Taylor Way Plant Site, and into future administrative actions for implementation of the cleanup action” (Ecology 2021). Ecology made this determination based on a 2020 Port request since it would expedite remediation of the NBA. The Port and USG do not agree which party has financial responsibility for remediating NBA contamination. Since Ecology does not assign financial responsibility in these situations, Ecology expects the parties to address financial responsibility for remediation of the NBA through negotiation and/or litigation.

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[11] A variety of studies have demonstrated that arsenic and lead concentrations in sea salts and rock salts are very low, including (1) mean total inorganic and organic arsenic concentrations between 0.0442 mg/kg and 0.0621 mg/kg in sea salts from Korea, Vietnam, China, Australia, and New Zealand (Hwang et al. 2021), (2) non-detect arsenic and lead concentrations in eight different rock salts used in Pennsylvania (Pennsylvania Department of Environmental Protection 2011), (3) mean arsenic and lead concentrations of non-detect (less than 0.01 mg/kg) and 0.13 mg/kg, respectively, in 31 different rock salts sold in Australia (Fayet-Moore et al. 2020), and (4) mean arsenic and lead concentrations of 0.094 mg/kg and 0.438 mg/kg, respectively, in 70 different rock salts used in Iran (Cheraghali et al. 2010). Similarly, arsenic and lead concentrations in North Pacific and North Atlantic ocean waters are very low (i.e., 1.5 ug/L to 1.8 ug/L for arsenic and 0.0062 ug/L to 0.031 ug/L for lead [Salbu and Steinnes 1995]).

Agreed Order No. DE 3405 between Ecology, USG, and the Port governs the supplemental RI, FS, and draft CAP phases of work for the Former USG Taylor Way Plant Site (Cleanup Site ID No. 5003).[12] USG is the potentially liable party performing the work under this Agreed Order due to its hazardous substances releases from its manufacturing operations and contractual obligation with Thermafiber, while the Port is a potentially liable party due to its current ownership of the USG Property (the Port purchased the property in December 2002).[13] The Supplemental RI Report and the FS report for the USG Property were completed in September 2016 and March 2021, respectively (CDM Smith 2016, 2021). A draft CAP is currently being prepared. This NBA Focused FS Report will be summarized in the draft CAP and issued for public comment along with the draft CAP and FS report for the USG Property.

MTCA investigation and remediation work at the Former Arkema Manufacturing Site (Cleanup Site ID No. 3405) has been governed by Agreed Order No. DE 5668 between Ecology and the Port since 2011. This agreed order includes provisions to complete the RI, FS, and draft CAP phases of work. The RI report for the entire Arkema Property was completed in 2013 (DOF 2013). A FS Report for the entire Arkema Property (minus the NBA) was submitted to Ecology in April 2021.

2.5 Overview of Relevant Remedial Investigation and Interim Action Chronology

RI activities have been completed within the NBA and adjacent areas and Ecology has approved the applicable RI reports (DOF 2013; CDM Smith 2016; Ecology 2013, 2016). In addition, interim actions (IAs) that included soil excavations and associated confirmational sampling (i.e., sidewall and bottom samples) have been completed on the USG Property adjacent to the NBA. A summary of all RI and IA sampling locations and associated concentration results within the NBA and adjacent areas are presented in Appendix A. In summary, RI and IA activities within the NBA and adjacent areas included:

- 1986 - 1990: Installation of a soil cap/cover on Waggoner's Wallow with an estimated thickness of 0.4 to 2.4 feet (AWARE Corporation 1981; Kennedy/Jenks/Chilton 1990; DOF 2013; PIONEER 2017).[14] While bark sludge was a component of the cap/cover (e.g., the top portion of the cap/cover in some portions of Waggoner's Wallow), it is currently unknown if bark sludge comprises all of the cap/cover installed over Waggoner's Wallow.
- 1989: Collection of Waggoner's Wallow sludge samples (WWS-series) from locations that had not previously received a cap/cover (Kennedy/Jenks/Chilton 1990).
- 1990: Collection of bark sludge samples (BSL-series) from locations where bark sludge was applied in the NBA and adjacent areas on the Arkema Property between 1986 and 1990 (Boateng 1990).

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[12] This agreed order was signed in 2006 and amended in 2015. Previously, MTCA investigation and cleanup activities at the Former USG Taylor Way Plant Site were completed in accordance with a 1994 agreed order (as amended) between Ecology and USG.

[13] USG indemnified Thermafiber when it sold the USG Property to Thermafiber in 1996. Thermafiber indemnified the Port when it sold the USG Property to the Port in 2002.

[14] The AWARE Corporation 1981 reference is for the estimated cap/cover thickness (based on the estimated depth to sludge in 1981), while the other references are for the cap/cover installation dates.

- 1994 - 1998: Collection of soil samples representative of pre-remediation conditions (i.e., S-series, MW9-1, MW13, HA-series, and B-DS4-series)[15] on the USG Property (AGI Technologies 1995, 1996, 1998).
- 1999: Excavation and off-site disposal of 4,144 tons of arsenic- and lead-impacted waste and soil from the MW9 area during a USG IA (see Figure 1-1). Sidewall samples (SW-series) and bottom samples (B-DS5-series) were collected from the excavation, including five sidewall samples on the Arkema Property approximately five feet south of the boundary between the USG Property and the Arkema Property (AGI Technologies 2000).[16]
- 2002 - 2005: Collection of soil samples representative of pre-remediation conditions from borings and test pits in the B13 and B23 areas (i.e., B-DS6-series, B13-series, B23-series, B13W40, B13W41, and B13F42) on the USG Property (Kennedy/Jenks Consultants 2002; CDM 2005).
- 2003 - 2012: Collection of soil samples (AT-series, PT-series, SPA-series, and NB-series) from within the NBA and adjacent areas on the Arkema Property (Boateng 2003; Malcolm Pirnie 2007; DOF 2013).
- 2005: Excavation and off-site disposal of 8,176 tons of arsenic- and lead-impacted waste and soil from the B13 and B23 areas during a USG IA (see Figure 1-1; CDM 2005).[17]
- 2006 - 2013: Collection of soil samples representative of currently existing conditions from borings (i.e., MW13R-2, MW1R-1, DPT-series, NB-series, and SUPFS-1)[18] on the USG Property (CDM Smith 2016; DOF 2013; Pacific Environmental & Redevelopment Corporation and PIONEER 2013).
- 2008 and 2012: Collection of groundwater samples from MWs within the NBA and adjacent areas on the Arkema Property (DOF 2013).[19]
- 2012: Electron microprobe (EMP) analysis of nine soil samples collected in 2012 from eight NB-series borings within and adjacent to the NBA (CDM Smith 2013). The EMP analyses were able to identify the presence of wastes in NBA soil that could not be seen with the naked eye.[20]

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[15] Suffixes were added to site identification numbers (Site IDs) as necessary to facilitate data management. For instance, the "-DS4," "-DS5," and "-DS6" suffixes were added to differentiate between borings with the same Site ID.

[16] The MW9 area excavation did not extend deep enough or far enough into the NBA to capture all of the contiguous arsenic- and lead-impacted soil within the NBA. The MW9 area excavation was only approximately three to five feet deep and the five excavation sidewall samples collected within the NBA were only approximately two to three feet deep. By contrast, high arsenic and lead soil concentrations were present in thin layers at depths on the order of 5.5 to 6.5 feet within the 2012 NBA soil borings abutting this southern sidewall (e.g., arsenic and lead concentrations of 2,682 mg/kg and 9,184 mg/kg, respectively, in NB-10 at 5.5 feet bgs, arsenic and lead concentrations of 3,009 mg/kg and 10,474 mg/kg, respectively, in NB-11 at 6.5 feet bgs, and arsenic and lead concentrations of 4,653 mg/kg and 2,077 mg/kg, respectively, in NB-15 at 6.5 feet bgs).

[17] Although excavation sidewall and bottom samples were collected, these data are not presented in this Report because the samples are not representative of pre-remediation conditions on the USG Property, and the B13 area and B23 area excavations did not extend onto the Arkema Property like the 1999 MW9 area excavation.

[18] Borings NB-2 and NB-12 were collected from previously excavated areas (see Appendix A); therefore, samples collected from these borings are not representative of pre-remediation conditions.

[19] Although groundwater samples were also collected from MWs within the NBA and adjacent areas prior to 2008, the Ecology-approved RI report for the Arkema Property relied upon the more recent groundwater results from 2008 and 2012.

[20] The fact that wastes in NBA soil can be microscopic means that field visual indicators cannot be relied upon to determine the presence/absence of elevated arsenic and lead concentrations in NBA soil. As a result, future NBA soil sampling to determine excavation extents will likely need to include extensive field x-ray fluorescence (XRF) screening prior to collection of final confirmational soil samples.

- 2017: Collection of groundwater samples from MWs within the NBA and adjacent areas on the Arkema Property (PIONEER 2019).

2.6 Development of NBA Constituents of Potential Concern

The purpose of this section is to develop NBA-specific constituents of potential concern (COPCs) since NBA-specific COPCs have not been previously defined. As a result, a screening evaluation of NBA-specific sampling results was conducted to verify that arsenic and lead are the only NBA COPCs. The NBA-specific screening evaluation consisted of the following two steps:

- An initial evaluation of the 13 COPCs identified in the Arkema Property RI report to determine which of these 13 COPCs were potentially applicable to the NBA.[21] Since (1) samples collected from the NBA were analyzed for a wide variety of constituents (including constituents that could have been released to the NBA and the 13 COPCs) as summarized in the Ecology-approved Arkema Property RI (DOF 2013), and (2) the COPC identification process in the Ecology-approved Arkema Property RI report compared maximum soil and groundwater concentrations across the entire Arkema Property (including NBA soil and groundwater concentrations) with MTCA screening levels (SLs), the 13 Arkema Property COPCs are by definition a conservative and appropriate starting place from which to determine NBA-specific COPCs.
- A comparison of NBA maximum concentrations for COPCs retained after the aforementioned step with SLs.

2.6.1 Initial Evaluation

Arsenic (soil and groundwater) and lead (soil only) are the presumptive metal COPCs for the NBA because the magnitude and extent of arsenic and lead concentrations in the NBA are greater than the other metal COPCs, and arsenic and lead pose a potential risk that is greater than the other metal COPCs (DOF 2013; CDM Smith 2016).[22] However, other metal COPCs previously identified in the Arkema Property RI report that may have elevated concentrations and need to be evaluated for the NBA include chromium, copper, mercury, nickel, selenium, and zinc (DOF 2013; CDM Smith 2016). Copper, mercury, and nickel were retained for further evaluation during the second step of the screening evaluation. Chromium, selenium, and zinc were eliminated as NBA COPCs since these three metals were identified in the Arkema Property RI as COPCs solely due to the potential terrestrial ecological pathway (DOF 2013). However, the NBA is excluded from a terrestrial ecological evaluation in accordance with WAC 173-340-7491(1)(b) because the NBA will be redeveloped and covered by buildings, paved roads, pavement, and/or other physical barriers once cleanup is completed. The current and future land use for the NBA is Port Maritime Industrial (PMI) use, and the Port estimates NBA industrial redevelopment

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[21] The 13 COPCs for soil and/or groundwater were arsenic, lead, copper, mercury, nickel, tetrachloroethylene, trichloroethylene, vinyl chloride, chloroform, chromium, dichloro-diphenyl-trichloroethane (DDT), selenium, and zinc (DOF 2013).

[22] Lead was screened out as a groundwater COPC for the NBA (and the rest of the Arkema Property) in the Ecology-approved Arkema Property RI report in 2013 when the NBA was part of the Arkema Property cleanup (DOF 2013). During the 2017 GWM event, dissolved lead was only detected in one of the ten NBA MWs (2B1-1) at a concentration (9.5 ug/L) slightly exceeding the lead groundwater SL of 8.1 ug/L (the maximum detection limit in the nine other NBA MWs was 2 ug/L). The very slight groundwater SL exceedance at 2B1-1 is insignificant and will be addressed by addressing arsenic and lead soil exceedances (e.g., 2B1-1 is located immediately adjacent to a proposed Alternative 3 excavation).

of the NBA (e.g., construction of industrial operational areas and buildings, installation of an industrial working surface) will occur no later than 2030. Thus, chromium, selenium, and zinc are not considered COPCs in this Report.

DDT, which was also identified in the Arkema Property RI as a COPC solely due to the potential terrestrial ecological pathway, was also eliminated as an NBA COPC in accordance with WAC 173-340-7491(1)(b) for the reason presented in the previous paragraph.

Tetrachloroethylene, trichloroethylene, vinyl chloride, and chloroform were identified as COPCs in the RI report for the Arkema Property but are not COPCs for the NBA since the SL exceedances for these constituents are located outside of the NBA (DOF 2013). In other words, there were no SL exceedances for these volatile constituents in the samples collected from the NBA (see Section 5.0 of DOF 2013).

2.6.2 Further Evaluation of Retained COPCs

Maximum soil and groundwater concentrations within the NBA and adjacent areas on the Arkema Property were compared to SLs to further evaluate the potential applicability of the five COPCs retained after the initial evaluation step (i.e., arsenic, lead for soil only, copper, mercury, and nickel) to the NBA. Soil and groundwater SLs for these COPCs are presented in Tables 2-1 and 2-2, respectively. With the exception of lead, the soil direct contact SLs are Standard Method B soil direct contact cleanup levels (CLs) for unrestricted land use and Standard Method C soil direct contact CLs for industrial land use in accordance with WAC 173-340-740(3)(b)(iii)(B) and WAC 173-340-745(5)(b)(iii)(B), respectively.[23] The lead soil direct contact SLs are MTCA Method A soil CLs for unrestricted land use and industrial land use. The groundwater SLs are Standard Method B surface water CLs in accordance with WAC 173-340-730(3)(b)(i) and 173-340-730(3)(b)(iii) for the protection of potential downgradient surface water and sediment receptors. Comparisons of maximum soil and groundwater concentrations with the SLs are presented in Table 2-3. Soil and groundwater sampling locations and associated concentration results within the NBA and adjacent areas for these five COPCs are presented in Appendix A.

In accordance with WAC 173-340-703, copper, mercury, and nickel were eliminated as NBA COPCs for the purposes of this Report and proposed excavation activities because:[24]

- The maximum copper, mercury, and nickel soil concentrations in the NBA were less than soil direct contact SLs for an unrestricted land use scenario.
- The maximum mercury groundwater concentration was less than the mercury groundwater SL.

[23] Soil-to-groundwater SLs were not used in this section because (1) IAs on the USG Property have demonstrated that soil excavation can dramatically reduce arsenic concentrations in groundwater, (2) excavation of arsenic and lead soil impacts is proposed for the NBA, (3) comparisons of actual groundwater data and groundwater SLs were used in the evaluation, (4) the arsenic soil-to-groundwater SL (20 mg/kg) is the same value as the Standard Method B soil direct contact CL for unrestricted land use, and (5) the lead soil-to-groundwater SL (3,000 mg/kg) is greater than the MTCA Method A soil CL for unrestricted land use (250 mg/kg).

[24] Although copper, mercury, and nickel are not discussed further in this Report and will not be analyzed as part of excavation activities, periodic analyses of copper and nickel will be incorporated into confirmational groundwater monitoring (since there is at least one current groundwater SL exceedance for copper and nickel).

- Copper and nickel groundwater concentrations only exceeded groundwater SLs in two MWs (1B4-1 and 2B1-1), and the maximum copper and nickel groundwater concentrations were only 4.8 and 2.2 times higher than their groundwater SLs, respectively (see Table A-2 in Appendix A and Table 2-3). Focusing on arsenic and lead as the NBA COPCs will address these slight copper and nickel exceedances. For instance, 11 of the 12 soil samples with copper concentrations exceeding 200 mg/kg are included in proposed Alternative 3 excavations due to elevated arsenic and lead soil concentrations in the samples.[25] Likewise, the two MWs with copper and nickel groundwater SL exceedances (1B4-1 and 2B1-1) are located within or immediately adjacent to a proposed Alternative 3 excavation.
- Any potential risk posed by copper, mercury, and nickel in the NBA is negligible compared to the potential risk posed by arsenic and lead in the NBA.
- The nature and extent of metals concentrations in the NBA indicate that arsenic and lead are suitable indicator hazardous substances for defining NBA cleanup requirements. The USG FS report also selected arsenic and lead as indicator hazardous substances for metals impacts on the USG Property (CDM Smith 2021).

Thus, the screening evaluation confirmed that the NBA COPCs are arsenic in soil and groundwater and lead in soil.

2.7 Nature and Extent of Arsenic and Lead SL Exceedances

The exceedances of the arsenic and lead soil direct contact SLs for industrial land use are typically present in relatively thin layers on top of the historical ground surface, with the nature and extent of the exceedances dependent on the transport/deposition mechanism. The maximum arsenic and lead soil concentrations at each sampling location are summarized on Figures 2-4A and 2-4B, respectively, while the maximum arsenic and lead concentrations within different depth intervals are summarized on Figures 2-5A and 2-5B, respectively. Soil sampling locations and associated concentration results are included within Appendix A. PIONEER has concluded there are two types of transport/deposition mechanisms and two distinct areas of contamination as highlighted in the aforementioned figures and discussed in the following two paragraphs.

The primary area of arsenic and lead soil contamination is located in the northern portion of the NBA contiguous with the MW9 excavation (see Figures 2-4A through 2-5B). This area is generally defined by the following 18 existing soil sampling locations that had at least one exceedance of an arsenic or lead soil direct contact SL for industrial land use: SW24, SW27 through SW30, NB-10, NB-11, NB-13 through NB-18, NB-25, NB-26, NB-30, NB-31, and SPA-04. The nature of arsenic and lead exceedances in these 18 soil sampling locations is summarized as follows:

- Exceedances of soil direct contact SLs for industrial land use are typically encountered in relatively thin layers of contamination. PIONEER has concluded the thin layers of contamination in this area were transported from stockpiles/fill via gravity, wind, stormwater runoff, and/or grading/filling activities to the NBA and deposited on top of the historical ground surface of this

[25] The 11 samples are NB-10 at 5.5-5.6 feet bgs, NB-11 at 6.5-7 feet bgs, NB-13 at 6.5 feet bgs, NB-15 at 6-6.5 feet bgs, NB-16 at 5.3-5.5 feet bgs, NB-17 at 6 feet bgs, NB-26 at 6.5 feet bgs, NB-31 at 5.3 feet bgs, NB-37 at 2.5 feet bgs, NB-42 at 2 feet bgs, and NB-49 at 1 foot bgs (see Table A-1 in Appendix A). The 12th sample (SPA-05 at 0.25-6 feet bgs) was a composite sample collected adjacent to a proposed Alternative 3 excavation area.

formerly low-lying area. This contamination was subsequently covered with fill material (e.g., general fill soil, construction debris, bark sludge).

- The maximum arsenic and lead concentrations in this area were 7,331 mg/kg and 10,474 mg/kg, respectively.
- Fifteen of the 18 soil sampling locations within this area had at least one sample with an exceedance of the arsenic remediation level (RL) for chronic-based exposures (400 mg/kg) used in the USG FS report (CDM Smith 2021).
- Nine soil borings in this area had at least one sample with an exceedance of the arsenic RL for acute-based exposures (1,060 mg/kg) used in the USG FS report (CDM Smith 2021). Eight of those nine soil borings also had at least one sample with a lead concentration exceeding the soil direct contact SL for industrial land use (1,000 mg/kg).
- Arsenic and lead concentrations exceeding the RL for acute-based exposures (1,060 mg/kg) and soil direct contact SL for industrial land use (1,000 mg/kg), respectively, were encountered in the aforementioned nine borings at depths ranging from 5 to 11 feet bgs.
- Existing data suggests that a significant portion of the overburden does not have exceedances of soil direct contact SLs for industrial land use. There were no arsenic or lead soil direct contact SL exceedances for industrial land use in the top 4.9 feet of soil in 10 of the 13 borings within this area. However, there were slight exceedances of the arsenic soil direct contact SL for industrial land use (88 mg/kg) in NB-16 (at 2 feet bgs) and NB-18 (at the ground surface), there was an exceedance in the 0.25-6 feet bgs composite sample at SPA-04, and there were exceedances in all five MW9 excavation sidewall samples collected within the NBA (at 2-3 feet bgs).
- Based on empirical NBA data and experience at the USG Property (CDM Smith 2016), arsenic appears to have leached from the original deposition layer in select locations (e.g., NB-15, NB-17, NB-25, and NB-26) and subsequently adsorbed/precipitated onto deeper soil, causing deeper exceedances of the soil direct contact SL for industrial land use in those locations. By contrast, lead has remained relatively immobile within the original deposition layer and has not caused exceedances of the soil direct contact SL for industrial land use in deeper soil.
- Although arsenic and lead soil concentrations are generally lower in deep samples and exceedances of soil direct contact SLs for industrial land use have been vertically delineated in some of the 18 soil sampling locations within this area, further vertical delineation is warranted for SW24, SW27 through SP30, NB-11, NB-15, NB-17, NB-25, NB-26, and SPA-04 since the deepest sample at these locations had a soil direct contact SL for industrial land use exceedance.

A secondary area of arsenic and lead soil contamination includes the western and southern portions of the NBA (see Figures 2-4A through 2-5B). This area is generally defined by the following 18 existing soil sampling locations that had at least one exceedance of an arsenic or lead soil direct contact SL for industrial land use: NB-6, NB-8, NB-19, NB-20, NB-34 through NB-37, NB-42, NB-43, NB-46 through NB-49, SPA-03, and WWS-3 through WWS-5. The nature of arsenic and lead exceedances in these 18 soil sampling locations is summarized as follows:

- Exceedances of soil direct contact SLs for industrial land use are typically encountered in relatively thin layers of contamination. PIONEER has concluded the thin layers of contamination in this area were transported from airborne emissions and deposited on top of the historical ground surface. This contamination was subsequently covered with a relatively thin layer of fill material (e.g., bark sludge).

- The maximum arsenic and lead concentrations in this area were 1,730 mg/kg and 5,975 mg/kg, respectively, although most arsenic and lead concentrations in this secondary area are lower than the primary area contiguous with the MW9 excavation.
- Seven of the 18 soil sampling locations within this area had at least one sample with an exceedance of the arsenic RL for chronic-based exposures (400 mg/kg) used in the USG FS report, while two locations had at least one sample with an exceedance of the arsenic RL for acute-based exposures (1,060 mg/kg) used in the USG FS report (CDM Smith 2021). The four locations with the highest arsenic concentrations (i.e., NB-35, NB-37, NB-42, and NB-49) also had lead concentrations exceeding the soil direct contact SL for industrial land use (1,000 mg/kg).
- Almost all exceedances of soil direct contact SLs for industrial land use within this area were encountered in the top five feet of soil. A notable exception was NB-46, which had arsenic exceedances of the soil direct contact SL for industrial land use (88 mg/kg) at depths between five and 12.5 feet bgs.
- Any leaching of arsenic and lead from the original deposition layer and subsequent adsorption/precipitation onto deeper soil has not resulted in deeper exceedances of the soil direct contact SLs for industrial land use within this area, with the possible exceptions of NB-6, NB-19, and NB-46.
- Although arsenic and lead soil concentrations are generally lower in deep samples and exceedances of soil direct contact SLs for industrial land use have been vertically delineated in 12 of the 18 soil sampling locations within this area, further vertical delineation is warranted for NB-19, NB-46, SPA-03, and WWS-3 through WWS-5 since the deepest sample at these locations had a soil direct contact SL for industrial land use exceedance.

Arsenic groundwater SL exceedances are present throughout the NBA due to the arsenic soil contamination discussed in the previous two paragraphs. The most recent (2017) dissolved arsenic groundwater concentrations within the NBA relative to the arsenic groundwater SL of 8 ug/L are shown on Figure 2-6. Dissolved arsenic groundwater concentrations in the NBA are highest in the Surface Aquifer, with the most recent concentrations ranging from 52 ug/L in MW 1B4-1 to 751 ug/L in MW 1C3-1 on the upgradient (west) side of the NBA. The elevated dissolved arsenic concentration in MW 1C3-1 may be associated with the deep soil contamination in the saturated zone at NB-46. The most recent dissolved arsenic concentration in the Surface Aquifer on the downgradient (east) side of the NBA near the Hylebos Waterway was 58 ug/L in MW 3A3-1R. Dissolved arsenic groundwater concentrations decrease substantially with depth. There was a slight dissolved arsenic groundwater SL exceedance in Second Aquifer MW 2B2-2 (15 ug/L) during the most recent event, and the concentration in the downgradient Second Aquifer MW on the east side of the NBA (3.4 ug/L in 3A2-2R) was less than the arsenic groundwater SL. There were no exceedances of the arsenic groundwater SL in the two NBA Deep Aquifer MWs (1C1-3 and 3A1-3R). Although substantial natural attenuation of arsenic groundwater concentrations between upland MWs similar to 3A3-1R and Hylebos Waterway surface water has been demonstrated on the Arkema Property (PIONEER 2019), the potential discharge of arsenic in Surface Aquifer groundwater to the Hylebos Waterway remains a groundwater concern for the NBA.

A comparison of paired toxicity characteristic leaching procedure (TCLP) arsenic and total arsenic soil concentrations for three existing data sets (i.e., 1998 MW9 area investigation samples [AGI Technologies

1998], 1999 MW9 excavation sidewall and stockpile samples [AGI Technologies 2000], and four 2012 NBA soil samples) is shown on Figure 2-7. Based on the results in Figure 2-7, NBA solid waste with total arsenic concentrations that exceed approximately 1,000 mg/kg will likely be characteristic hazardous waste.

2.8 Land Use

The NBA is currently vacant, undeveloped, and covered with soil and vegetation. A perimeter fence with warning signs is present around the Arkema Property, including the NBA. The planned future land use for the NBA and adjacent areas on the Arkema Property is Port Maritime Industrial (PMI), consistent with the Port's Land Use Plan (Port 2014) and local zoning.

2.9 Conceptual Site Model

A summary of the current CSM for the NBA is presented in this section. The CSM includes source, transport, and exposure components. The NBA CSM will be updated as new information is obtained.

The most pertinent source, transport, and future characterization components of the NBA CSM include (PIONEER 2017):

- Historical USG manufacturing operations adjacent to the NBA generated arsenic- and lead-contaminated wastes.
- These wastes were stockpiled, used as fill material, and emitted from smokestacks adjacent to the NBA.
- PIONEER concluded stockpiles/fill containing elevated arsenic and lead soil concentrations were transported to the low-lying areas in the NBA via gravity, wind, stormwater runoff, and/or grading/filling activities.
- Arsenic and lead were also transported throughout the NBA via airborne deposition.
- The arsenic- and lead-impacted soil deposited in the NBA was subsequently covered by fill material (e.g., construction debris, bark sludge) that had low arsenic and lead concentrations.
- Arsenic appears to have leached to deeper soil in some locations, but the lead has remained relatively immobile (see Section 2.7).
- Some zones of soil contamination within the NBA cannot be seen with the naked eye, which will affect the confirmation soil sampling approach (see Section 2.5).

The following exposure pathways are considered potentially complete for contamination within the NBA:

- Incidental ingestion of surface soil by future NBA construction workers, future NBA industrial workers, and current/future NBA trespassers.
- Incidental ingestion of subsurface soil by future NBA construction workers and future NBA utility workers.
- Absorption and bioaccumulation by marine aquatic organisms in the Hylebos Waterway (due to potential transport of arsenic-impacted groundwater to surface water via direct groundwater discharge or infiltration to the Taylor Way storm sewer and subsequent storm sewer discharge).
- Incidental ingestion of surface water and sediment and consumption of marine aquatic organisms by recreators/fishers in the Hylebos Waterway (due to potential transport of arsenic-

impacted groundwater to surface water via direct groundwater discharge or infiltration to the Taylor Way storm sewer and subsequent storm sewer discharge).

Consistent with the USG FS report (CDM Smith 2021), the following pathways are incomplete or insignificant for the NBA:

- Dermal contact with soil and inhalation of particulates from soil by future construction workers, future industrial workers, current/future trespassers, and future utility workers were deemed insignificant relative to incidental ingestion of soil by these receptors.
- Dermal contact with groundwater by future construction and utility workers was deemed insignificant relative to incidental ingestion of soil by these receptors.
- Dermal contact with surface water and sediment by recreators/fishers in the Hylebos Waterway were deemed insignificant relative to incidental ingestion of surface water and sediment by recreators/fishers.
- Ingestion and dermal contact by receptors using groundwater as drinking water are incomplete pathways because NBA groundwater is not currently used as drinking water and NBA groundwater is not a suitable future drinking water source due to salt content.
- The terrestrial ecological pathway is incomplete as described in Section 2.6.1.

SECTION 3: CLEANUP ACTION OBJECTIVES, CONSTITUENTS OF CONCERN, AND CLEANUP STANDARDS

CAOs, COCs, and cleanup standards are defined in this section to provide a basis for developing the alternatives, evaluating the alternatives, and determining the ultimate success of the selected alternative during cleanup action implementation.

3.1 Cleanup Action Objectives

CAOs are written objectives of what the recommended alternative should accomplish for the potentially complete exposure pathways (see Section 2.9). The NBA CAOs are to protect human health and the environment by:

- Preventing unacceptable exposures associated with incidental ingestion of soil by future NBA construction workers, future NBA industrial workers, current/future NBA trespassers, and future NBA utility workers.
- Ensuring groundwater concentrations discharging to Hylebos Waterway surface water downgradient of the NBA are protective of marine aquatic organisms and recreators/fishers.

3.2 Constituents of Concern

The NBA COCs will be the same constituents retained as COPCs in Section 2.6: arsenic in soil and groundwater and lead in soil.[26]

3.3 Cleanup Standards

In accordance with WAC 173-340-700(3), cleanup standards "consist of the following: (a) cleanup levels for hazardous substances present at the site; (b) the location where these cleanup levels must be met (point of compliance); and (c) other regulatory requirements that apply to the site because of the type of action and/or location of the site ('applicable state and federal laws')."

3.3.1 Soil Cleanup Levels and Remediation Levels

The primary soil CLs for this Report are the Industrial Soil CLs of 88 mg/kg for arsenic and 1,000 mg/kg for lead. These Industrial Soil CLs are identical to the soil direct contact SLs for industrial land use presented in Section 2.6.2. However, one alternative utilizes Unrestricted Soil CLs to evaluate the potential benefit of not having to rely upon institutional controls (ICs) for perpetuity. The Unrestricted Soil CLs of 20 mg/kg for arsenic and 250 mg/kg for lead are identical to the soil direct contact SLs for unrestricted land use in Section 2.6.2. In addition, the arsenic Unrestricted Soil CL of 20 mg/kg is equal to the arsenic soil-to-groundwater CL of 20 mg/kg.[27]

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[26] Although arsenic and lead are the indicator hazardous substances for the purposes of this Report and excavation activities, periodic analyses of copper and nickel will be incorporated into confirmational groundwater monitoring (see Section 2.6.2).

[27] The arsenic soil-to-groundwater CL was calculated using the fixed parameter three-phase model in WAC 173-340-747(4) and the groundwater CL in Section 3.3.3, with an adjustment per WAC 173-340-740(5)(c) up to the Ecology-established arsenic soil

Arsenic soil RLs included in the USG FS report (400 mg/kg for chronic-based exposures and 1,060 mg/kg for acute-based exposures) were also utilized when developing alternatives (CDM Smith 2021). These soil RLs were developed based on a utility worker soil direct contact exposure scenario (CDM Smith 2021).

3.3.2 Soil Point of Compliance

Since the NBA soil cleanup standards are based on incidental soil ingestion, the NBA soil point of compliance (POC) is from ground surface to 15 feet bgs in accordance with WAC 173-340-745(7) and 173-340-740(6)(d). All alternatives that include soil containment (i.e., cap/cover) will be capable of satisfying this POC in accordance with WAC 173-340-740(6)(f) by including ICs and compliance monitoring as remedial components.

3.3.3 Groundwater Cleanup Level

The NBA groundwater CL for dissolved arsenic is 8 ug/L, a value identical to the groundwater SL in Section 2.6.2.[28] The SL and CL were based on protection of surface water, with a necessary WAC 173-340-720(7)(c) adjustment to account for the Puget Sound Basin arsenic natural background concentration of 8 ug/L (Ecology 2022).

3.3.4 Groundwater Point of Compliance

It is not practicable to achieve the arsenic groundwater CL within the standard groundwater POC (i.e., throughout the entire NBA) within a reasonable restoration time frame since (1) the current maximum arsenic groundwater concentration in the NBA (751 ug/L in 1C3-1) is two orders of magnitude greater than the CL, (2) arsenic soil contamination is dispersed across the entire NBA (as a result of how the contamination was transported to the NBA), (3) there will most likely still be arsenic soil mass in portions of the NBA (even after extensive excavation activities) that could cause future arsenic groundwater concentrations to exceed the CL, and (4) upgradient arsenic groundwater concentrations exceeding the CL are present from upgradient former industrial operations (PIONEER 2015). In addition, the potential groundwater-related receptors of concern are located in the Hylebos Waterway (and not within the NBA). As a result, an on-property conditional groundwater POC that is "as close as practicable to the source of hazardous substances" is proposed as allowed under WAC 173-340-720(8)(c).

3.3.5 Other Regulatory Requirements

No other applicable state and federal laws or regulations have been identified at this time that would modify the cleanup standards given the type of alternatives being considered for the NBA or the location of the NBA. However, a preliminary evaluation of potentially applicable or relevant and

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background concentration of 20 mg/kg (see Footnote b in MTCA Table 740-1). The lead soil-to-groundwater CL of 3,000 mg/kg is greater than the Unrestricted Soil CL and Industrial Soil CL for lead.

[28] Since the groundwater CL is based on surface water regulations (e.g., Chapter 173-201A of the WAC, regulations developed pursuant to Section 304 of the Clean Water Act, and 40 Code of Federal Regulations 131) and these regulations explicitly indicate that the metals criteria are intended for use with dissolved metals, dissolved arsenic concentrations are used for evaluating compliance.

appropriate requirements for cleanup action implementation is included in Appendix B. Further assessment and/or action (e.g., obtaining permits) will be necessary before cleanup action implementation activities are initiated in order to address several of these requirements.

3.4 Summary of Cleanup Standard Exceedances

3.4.1 Soil

A summary of soil cleanup standard exceedances within the NBA and adjacent areas is presented on Figure 3-1. Arsenic and lead concentrations were placed into different concentration bins to show exceedances of Unrestricted Soil CLs, Industrial Soil CLs, and arsenic soil RLs. Concentration results were also divided into three different depth bins (i.e., 0-5 feet bgs, 5-10 feet bgs, and 10-15 feet bgs) within the 15-foot-deep soil POC.

3.4.2 Groundwater

As discussed in Section 2.7 and presented on Figure 2-6, arsenic groundwater CL exceedances are present throughout the NBA due to arsenic soil contamination. In summary, dissolved arsenic groundwater concentrations in the NBA are highest in the Surface Aquifer, with the most recent (2017) concentrations ranging from 52 ug/L in MW 1B4-1 to 751 ug/L in MW 1C3-1 on the upgradient (west) side of the NBA. Dissolved arsenic groundwater concentrations decrease substantially with depth. The maximum dissolved arsenic concentrations in the Second Aquifer and Deep Aquifer from the most recent (2017) sampling event were 15 ug/L at MW 2B2-2 and 1.6 ug/L at MW 3A1-3R, respectively.

Current MWs on the eastern boundary of the NBA (i.e., 3A3-1R, 3A2-2R, and 3A1-3R) are located within approximately 25 feet of the current shoreline and will likely serve as conditional POC MWs (see Figure 2-6). The 2017 dissolved arsenic concentrations in Surface Aquifer MW 3A3-1R, Second Aquifer MW 3A2-2R, and Deep Aquifer MW 3A1-3R were 58 ug/L, 3.4 ug/L, and less than 1.6 ug/L, respectively. The 2017 dissolved arsenic concentrations in these MWs were relatively consistent with previous concentrations (DOF 2013; PIONEER 2019).[29] Thus, the current exceedance of concern in these potential conditional POC MWs is a dissolved arsenic concentration in Surface Aquifer MW 3A3-1R that is roughly an order of magnitude higher than the 8 ug/L arsenic groundwater CL.

[29] The 2008 and 2012 dissolved arsenic concentrations in 3A3-1R were 28 ug/L and 30 ug/L, respectively. The 2008 and 2012 dissolved arsenic concentrations in 3A2-2R were 6 ug/L and 13.5 ug/L, respectively. The 2008 and 2012 dissolved arsenic concentrations in 3A1-3R were less than 2 ug/L and 1 ug/L, respectively.

SECTION 4: IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

In accordance with WAC 173-340-350(8)(b), potentially applicable remedial technologies were identified and reduced via a screening process to determine the most promising and feasible remedial technologies. The potentially applicable remedial technologies identified for the NBA were the remedial technologies retained in the USG FS report (CDM Smith 2021). Of these identified technologies, the most promising and feasible technologies retained for inclusion in the NBA alternatives based on the current conditions, CAOs, cleanup standards, and professional judgment were:

- Excavation and off-site disposal (including ex-situ stabilization as necessary to reduce the leachability of arsenic for waste disposal)
- In-situ groundwater treatment (e.g., placement of stabilization agent within excavation backfill)
- Installing and maintaining cap/cover (including visual inspections)
- Monitored natural attenuation (MNA)
- ICs (e.g., environmental covenant, access restrictions, community awareness)

SECTION 5: DEVELOPMENT OF THE CLEANUP ACTION ALTERNATIVES

A total of four alternatives were assembled based on the current conditions, CAOs, cleanup standards, retained remedial technologies in Section 4, and professional judgment. The four alternatives represent a representative array of remedial options, and all alternatives are capable of satisfying the CAOs and the cleanup standards. Since the alternatives utilize many of the same remedial components, each remedial component used in an alternative is conceptually described in Section 5.1. The remedial components included within a given alternative are listed in Section 5.2.

5.1 Description of Remedial Components

Remedial components used in one or more alternative are conceptually defined in the following sub-sections.

5.1.1 Excavation and Off-site Disposal

Excavation and off-site disposal would include the following conceptual elements:

- A pre-design investigation (PDI) would be conducted during the remedial design phase to (1) refine the excavation areas and depths, (2) collect pre-excavation confirmation sidewall and bottom samples,[30] and (3) further pre-characterize clean overburden soil that is located above contaminated soil.
- Following the remedial design, soil would be excavated until statistical compliance with the applicable soil cleanup standards (e.g., CLs and/or RLs depending on the alternative) is achieved as described in Section 5.1.2. The maximum excavation depth would be 15 feet bgs or two feet into the First Aquitard, whichever is shallower. Excavation would not proceed deeper than two feet into the First Aquitard because the First Aquitard provides an important attenuation barrier between the Surface and Second Aquifers. If the top portion of the First Aquitard was excavated, low-permeability backfill material would be placed and compacted in the First Aquitard portion of the excavation.
- Excavation dewatering would be conducted as necessary and water generated during dewatering would be (1) containerized and disposed of at an off-site facility permitted to receive the waste, (2) treated and re-used in accordance with an applicable permit, and/or (3) discharged to a sanitary or stormwater sewer in accordance with an applicable permit.
- Excavated soil and solid materials would be containerized or placed on concrete, asphalt, or plastic liners for waste characterization (and potential soil ex-situ stabilization) purposes.
- If the arsenic and/or lead TCLP concentrations exceeded applicable hazardous waste criteria in the soil stockpiles/containers, then ex-situ stabilization would likely be conducted to facilitate disposal of that soil as non-hazardous waste.

[30] In other words, the goal would be to maximize the use of pre-excavation confirmation samples (and minimize the use of post-excavation confirmation samples) to facilitate effective Port contracting, while also recognizing Ecology's stated desire for some post-excavation NBA confirmation sampling.

- Excavated soil and materials would be disposed of at an off-site facility permitted to receive the waste. It is anticipated that non-hazardous waste would be disposed of at the Pierce County Recycling, Composting and Disposal (does business as LRI) facility in Graham, Washington.
- Up to one foot of zero-valent iron mixed with sand would be placed at the bottom of each excavation (or on top of the low-permeability soil backfill if the top part of the First Aquitard was excavated) to provide additional groundwater treatment. The remainder of the excavation would be backfilled to original grade and compacted. All backfill material would be certified clean material from an off-site source, clean overburden soil (as determined during the PDI) that was excavated to access deeper soil, and/or existing stockpiled NBA soil (if it is proven to be clean and acceptable for use as backfill).[31]

5.1.2 Soil Statistical Compliance

For alternatives that include excavation (i.e., Alternatives 2 through 4), Ecology-approved statistical compliance methods would be used to determine when post-excavation arsenic and lead concentrations in the NBA have achieved the applicable soil cleanup standards (e.g., CLs and/or RLs depending on the alternative).[32] With the exception of arsenic for Alternative 2, the statistical compliance methods would be in accordance with WAC 173-340-740(7)(d) - (f). For instance, (1) the maximum post-excavation arsenic and lead concentrations would not exceed two times the applicable CLs (i.e., the lead Industrial Soil CL for Alternative 2, arsenic and lead Industrial Soil CLs for Alternative 3, and arsenic and lead Unrestricted Soil CLs for Alternative 4), (2) less than ten percent of the post-excavation samples would have an exceedance of the applicable CLs, and (3) the upper 95% confidence level of the mean post-excavation arsenic and lead soil concentrations would be less than the applicable CLs. In the case of arsenic for Alternative 2, statistical compliance would be evaluated consistent with the approach Ecology approved for arsenic RLs in the USG FS report (CDM Smith 2021). Specifically, the maximum post-excavation arsenic soil concentration would not exceed the arsenic RL for acute-based exposures (1,060 mg/kg), and the upper 95% confidence level of the mean post-excavation arsenic soil concentration in the NBA would not exceed the arsenic RL for chronic-based exposures (400 mg/kg).

5.1.3 Install and Maintain Cap/Cover

A cap/cover would be installed over existing soil where arsenic and/or lead soil concentrations exceed Industrial Soil CLs within the soil POC. It is anticipated that an asphalt and/or concrete working surface compatible with future Port Maritime Industrial (PMI) land uses would eventually be constructed and serve as the cap/cover. However, the cap/cover could also consist of one or more buildings, landscaping around the buildings, and/or gravel with a thickness of at least one foot. The nature of and the timing for installing the cap/cover would depend on redevelopment plans. If Alternative 1 or Alternative 2 (the two alternatives that include the cap/cover as presented in Section 5.2) is the selected alternative and an NBA redevelopment plan does not exist within six months after the final CAP is signed, then the Port

[31] The existing stockpiled NBA soil was generated in 2003 during the Arkema Salt Pad Bank Cleanup and Salt Marsh Relocation project along the northern portion of the Arkema Property shoreline (DOF 2011).

[32] Post-excavation samples include all soil samples that are still in place following excavation activities (e.g., RI and PDI samples that were not excavated, excavation confirmation samples).

would proceed with installing a gravel cover with a thickness of at least one foot as part of the implementation of Alternative 1 or Alternative 2. For the purposes of evaluating alternatives in this Report, the cap/cover for Alternatives 1 and 2 was assumed to consist of o ne foot of gravel since there is not a specific redevelopment plan for the NBA at this time. All material used to construct the cap/cover would be certified clean material from an off-site source. Periodic monitoring (i.e., visual inspections) of the cap/cover would be conducted in accordance with a future monitoring and maintenance plan. The cap/cover would be repaired as necessary based on monitoring results.

5.1.4 Monitored Natural Attenuation

MNA would consist of periodic groundwater monitoring and periodic MNA evaluations to evaluate the extent and rate of arsenic groundwater concentration reductions in the NBA from natural attenuation. The estimated restoration time frames for MNA to achieve groundwater cleanup standards following remediation construction activities (i.e., excavation and/or install cap/cover) are discussed in Section 6.2.3. Groundwater monitoring and periodic MNA evaluations (e.g., Mann-Kendall trend analyses) would be conducted pursuant to a future groundwater monitoring plan. MNA would continue until the arsenic groundwater concentrations at the groundwater conditional POC were less than the arsenic groundwater CL. MNA continency measures are presented in Section 7.

5.1.5 Institutional Controls

ICs would be utilized to minimize potential exposures during the remediation, post-remediation, redevelopment, and post-redevelopment phases. In accordance with WAC 173-340-440, ICs would likely include:

- Developing and recording (with Pierce County) an environmental covenant to restrict certain activities (e.g., unacceptable land uses, drinking water use).[33]
- Developing and implementing project-specific health safety plans for remediation activities and intrusive activities during the redevelopment and post-redevelopment phases.
- Implementing controls during remediation and redevelopment activities (e.g., site control, dust control).
- Maintaining perimeter fencing and signs around the NBA until soil cleanup standards are attained within the NBA.[34]

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[33] The environmental covenant would include additional provisions and requirements beyond the example restrictions outlined in this bullet. For instance, if Alternative 1 or Alternative 2 (the two alternatives that include the cap/cover as presented in Section 5.2) is the selected alternative, then the covenant would require Ecology notification and approval for any cap/cover disturbance.

[34] A perimeter fence and signs are currently located around the entire portion of the Arkema Property located at 2901 Taylor Way (including the NBA). If NBA soil cleanup standards are attainted prior to attainment of soil cleanup standards for the rest of the Arkema Property, the Port may elect to maintain the existing perimeter fence and signs. Alternatively, once NBA soil cleanup standards are attained, the Port may elect to modify the existing perimeter fence so that the NBA is not included within the fenced area.

5.2 Description of Cleanup Action Alternatives

The remedial components included within each alternative are shown in the following in-text table. Conceptual locations for cap/cover and excavation components in Alternatives 1 through 4 are shown on Figures 5-1 through 5-4, respectively. The final design of the selected alternative will likely differ slightly from the conceptual locations shown on Figures 5-1 through 5-4. For instance, the PDI outlined in Section 5.1.1 will most likely result in refined excavation locations and depths if Alternative 2, Alternative 3, or Alternative 4 is the selected alternative.

Remedial Component	Alternative 1 Cap/Cover, MNA, and ICs	Alternative 2 Excavate RLs, Cap/Cover, MNA, and ICs	Alternative 3 Excavate Industrial CLs, MNA, and ICs	Alternative 4 Excavate Unrestricted CLs and MNA
Excavation and Off-site Disposal		X	X	X
Soil Statistical Compliance (and associated Cleanup Standards)		X (Arsenic Soil RLs and Lead Industrial Soil CL)	X (Arsenic and Lead Industrial Soil CLs)	X (Arsenic and Lead Unrestricted Soil CLs)
Install and Maintain Cap/Cover	X	X		
MNA	X	X	X	X
ICs	X	X	X	

SECTION 6: EVALUATION OF THE CLEANUP ACTION ALTERNATIVES

The four alternatives developed in Section 5 were evaluated in this section using the MTCA remedy selection process and criteria described in WAC 173-340-360.

6.1 Evaluation Process and Criteria

The four alternatives were evaluated against the four MTCA threshold requirements for remedy selection in WAC 173-340-360(2)(a) and two of the three MTCA "other" requirements for remedy selection (also known as balancing criteria) in WAC 173-340-360(2)(b). The two "other" requirements evaluated in this Report were (1) “use permanent solutions to the maximum extent practicable”, and (2) “provide for a reasonable restoration time frame.” The third "other" requirement (i.e., "consider public concerns") was not evaluated at this time because public comments have not yet been solicited for this Report. The "consider public concerns" requirement will be formally evaluated after the public comment period for this Report and the draft CAP is completed.

6.1.1 MTCA Threshold Requirements Evaluation

The four MTCA threshold requirements are:

- “Protect human health and the environment”
- “Comply with cleanup standards”
- “Comply with applicable state and federal laws”
- “Provide for compliance monitoring”

The ability of a given alternative to satisfy these four threshold requirements was evaluated qualitatively by considering the nature and extent of COC exceedances, cleanup standards, the remedial components included in the alternative, and professional judgment. The MTCA threshold requirements evaluation is presented in Table 6-1.

6.1.2 Disproportionate Cost Analysis

In accordance with WAC 173-340-360(3)(b), a disproportionate cost analysis conducted with the methodology in WAC 173-340-360(3)(e) was used to determine if permanent solutions are being used to the maximum extent practicable. As stated in WAC 173-340-360(3)(b), the disproportionate cost analysis "shall compare the costs and benefits of the cleanup action alternatives evaluated in the feasibility study." Per WAC 173-340-360(3)(f)(iii), costs mean "the cost to implement the alternative, including the cost of construction, the net present value of any long-term costs, and agency oversight costs that are cost recoverable." On the other hand, the five specified benefits in WAC 173-340-360(3)(f) evaluated as part of the disproportionate cost analysis were:[35]

- Protectiveness: "Overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and offsite risks resulting from implementing the alternative, and improvement of the overall environmental quality."
- Permanence: "The degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated."
- Effectiveness over the long term: "The degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes."
- Management of short-term risks: "The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks."
- Technical and administrative implementability: "Ability to be implemented including consideration of whether the alternative is technically possible, availability of necessary offsite facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current or potential remedial actions."

In accordance with WAC 173-340-360(3)(e)(i), "costs are disproportionate to benefits if the incremental costs of the alternative over that of a lower cost alternative exceed the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative." In practice, this disproportionate cost determination often entails calculating the relative benefit/cost ratio for each alternative to see which alternative has the highest benefit/cost ratio. Typically, the alternative with the highest relative benefit/cost ratio satisfies the MTCA criterion to "use permanent solutions to the maximum extent practicable." However, in accordance with WAC 173-340-360(3)(a), the alternative with the highest relative benefit/cost ratio cannot be the selected alternative if it does not satisfy all of the four threshold requirements and the two "other" requirements. For this Report, a relative benefit/cost ratio was calculated for each alternative using the following steps:

- A ranking (score) was assigned to each of the five benefits based on professional judgment.
- Each ranking (score) was multiplied by a weighting factor. Consistent with the USG FS report (CDM Smith 2021), the weighting factors for the five benefits were:[36]
    - Protectiveness: 30%

[35] The sixth benefit (i.e., "consideration of public concerns") was not evaluated at this time because public comments have not yet been solicited for this Report. This benefit will be formally evaluated after the public comment period for this Report and the draft CAP is completed.

[36] When consideration of public concerns is evaluated, its weighting factor will be 10%.

  - Permanence: 20%
  - Effectiveness over the long term: 20%
  - Management of short-term risks: 10%
  - Technical and administrative implementability: 10%
- The individual weighted benefit scores were summed to calculate the total weighted benefit.
- An order of magnitude cost to implement each alternative was estimated on a net present value basis.
- The total weighted benefit was divided by the estimated cost to determine the relative benefit/cost ratio.

The scoring of benefits and the calculation of the relative benefit/cost ratios are presented in Table 6-2. The cost estimates used in the calculation of the relative benefit/cost ratios are presented in Appendix C.[37]

6.1.3 Reasonable Restoration Time Frame Evaluation

In accordance with WAC 173-340-360(4), an evaluation was conducted to determine if the alternatives provide for a reasonable restoration time frame. The restoration time frame is defined in WAC 173-340-200 as "the period of time needed to achieve the required cleanup levels at the point of compliance established at the site." Pursuant to WAC 173-340-360(4)(b), the factors to be considered when determining whether or not an alternative provides for a reasonable restoration time frame include the following:

- "Potential risks posed by the site to human health and environment;
- Practicability of achieving a shorter restoration time frame;
- Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site;
- Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site;
- Availability of alternative water supplies;
- Likely effectiveness and reliability of institutional controls;
- Ability to control and monitor migration of hazardous substances from the site;
- Toxicity of the hazardous substances at the site; and
- Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions."

The reasonable restoration time frame evaluation is presented in Table 6-3.

[37] The cost estimates in Appendix C were prepared solely to facilitate relative comparisons between alternatives for the purposes of this Report, and were intended to have an accuracy of roughly -30% to +50%.

6.2 Evaluation Results

6.2.1 MTCA Threshold Requirements Evaluation

Three of the four alternatives satisfy the MTCA threshold requirements (see Table 6-1). Alternative 1 did not satisfy all MTCA threshold requirements. In addition, the four alternatives differ in how the threshold requirements would be achieved. For instance, Alternative 4 utilizes removal of contaminated media to the greatest extent and is therefore considered the most permanent solution for the purposes of the disproportionate cost analysis. On the other hand, Alternative 2 relies on a cap/cover, MNA, and ICs to compensate for less removal of contaminated media.

6.2.2 Disproportionate Cost Analysis

The relative benefit/cost ratios in the disproportionate cost analysis from highest to lowest were (see Table 6-2):

- Alternative 3 (Excavate Industrial CLs, MNA, and ICs): 0.74
- Alternative 1 (Cap/Cover, MNA, and ICs): 0.49
- Alternative 2 (Excavate RLs, Cap/Cover, MNA, and ICs): 0.44
- Alternative 4 (Excavate Unrestricted CLs and MNA): 0.28

Based on these relative benefit/cost ratios, Alternative 3 utilizes permanent solutions to the maximum extent practicable.

6.2.3 Reasonable Restoration Time Frame Evaluation

Although the estimated soil restoration time frames for all four alternatives would be short and reasonable (e.g., once remediation construction activities are completed), not all of the alternatives provide for a reasonable groundwater restoration time frame (see Table 6-3). Alternatives 3 and 4 are expected to achieve the arsenic groundwater cleanup standard at the groundwater conditional POC (e.g., 3A3-1R) within approximately ten years based on results from the MW9 area IA (see Table 6-3), and both alternatives provide for a reasonable groundwater restoration time frame based on the evaluation in Table 6-3. By contrast, Alternative 1 does not provide for a reasonable groundwater restoration time frame at the groundwater conditional POC (e.g., 3A3-1R) because the restoration time frame is expected to be greater than 100 years and it is practicable to achieve a shorter groundwater restoration time frame. It is uncertain if Alternative 2 would provide for a reasonable groundwater restoration time frame at the groundwater conditional POC (e.g., 3A3-1R) given the limited amount of soil excavation in Alternative 2 and the relatively high arsenic concentrations that would remain in soil for perpetuity.

SECTION 7: THE RECOMMENDED CLEANUP ACTION ALTERNATIVE

The recommended cleanup action alternative is Alternative 3 (Excavate Industrial CLs, MNA, and ICs). Alternative 3 satisfies the four MTCA threshold requirements, uses permanent solutions to the maximum extent practicable, and achieves cleanup standards within a reasonable restoration time frame. Alternative 3 protects human health and the environment, removes substantial amounts of COC mass, employs reliable and proven technologies, can be implemented relatively quickly, is cost-effective, and does not contain any significant negative tradeoffs. Furthermore, Alternative 3 is consistent with the selected remedy (e.g., excavating soil to comply with the Industrial Soil CLs) for IAs on the USG Property (AGI Technologies 2000; CDM 2005), portions of the Arkema Property (DOF 2015b), and several nearby properties (e.g., DOF 2015a).[38]

In summary, the remedial components of Alternative 3 (see Section 5.1 for additional details) include:

- Excavation and off-site disposal to achieve statistical compliance with the Industrial Soil CLs (i.e., 88 mg/kg for arsenic and 1,000 mg/kg for lead);
- MNA activities (e.g., periodic groundwater monitoring and periodic MNA evaluations); and
- ICs (e.g., recording an environmental covenant to restrict unacceptable land uses and drinking water use, implementing project-specific health safety plans, maintaining perimeter fencing and signs).

Given the nature of Alternative 3 and the most recent (2017) dissolved arsenic groundwater concentration at 3A3-1R (58 ug/L), adaptive management and contingency measures are not expected to be necessary for the NBA. However, the Port will periodically evaluate the progress of MNA (e.g., every five years following completion of all soil excavations). At 10 years following completion of all soil excavations, if it is demonstrated through a groundwater trend evaluation that the arsenic groundwater cleanup level will not be achieved at the groundwater conditional POC (e.g., 3A3-1R) within a reasonable restoration time frame (30 years), then the Port will evaluate the need for some additional groundwater treatment.

Selection of Alternative 3 as the remedy is subject to Ecology approval after public review of this Report and the draft CAP. Once Ecology finalizes the CAP, the recommended cleanup action alternative will be implemented in accordance with the final CAP and the remedial design. The remedial design for the selected alternative may differ slightly from the alternative description presented in this Report based on agency decisions, input from the public and other stakeholders, supplemental data that will be collected to support the remedial design, and other new information that was not considered when developing this Report. Remedial design documents (e.g., construction plans and specifications) will be submitted to Ecology for review and approval prior to initiating cleanup action implementation.

[38] The MTCA industrial soil CL for arsenic was 200 mg/kg at the time of the 1999 IA on the USG Property (AGI Technologies 2000).

SECTION 8: REFERENCES

AGI Technologies. 1995. Phase II Remedial Investigation, USG Interiors, Prepared for USG Interiors, February 23.

AGI Technologies. 1996. Final Source Control Plan - Interim Actions, USG Interiors, Prepared for USG Interiors, February 12.

AGI Technologies. 1998. Soil Quality Assessment, USG Interiors, Prepared for USG Interiors, December 3.

AGI Technologies. 2000. Final Source Controls Implementation, USG Interiors, Prepared for USG Corporation, June 7.

AWARE Corporation. 1981. Hydrogeologic and Engineering Evaluations of Waste Management Facilities, Pennwalt Chemical Facility, Prepared for the Pennwalt Corporation, November.

Boateng. 1990. Results from Sampling and Analysis of Bark Sludge, ATOCHEM Facility, Prepared for ATOCHEM North America, October.

Boateng. 2002. Annual Report: Volatile Organic Compound Sampling for Natural Attenuation November 2002, Prepared for ATOFINA Chemicals, December.

Boateng. 2003. Collection and Analysis of Soil Samples at the Barrier Wall, ATOFINA Facility, Prepared for ATOFINA Chemicals, June.

CDM. 2005. June 2006 [sic] Interim Action Soil Excavation Summary Report, Former USG Interiors Facility, Prepared for USG Corporation, October 3.

CDM Smith. 2013. Report: Electron Microprobe Analysis, North Boundary Area Investigation, Former USG Facility and Former Arkema (aka Pennwalt) Facility, Prepared for USG Corporation, July 18.

CDM Smith. 2016. Supplemental Remedial Investigation, Agency-Review Final Draft, Former USG Taylor Way Plant Site, Prepared for USG Corporation, September 30.

CDM Smith. 2021. Feasibility Study, Former USG Taylor Way Plant Site, Public Review Draft, Prepared for USG Corporation, March 22.

Cheraghali, Abdol Majid et al. 2010. Heavy Metals Contamination of Table Salt Consumed in Iran, Iran Journal of Pharmaceutical Research, Spring, 9(2), pp. 129-132.

DOF. 2011. Remedial Action Construction Report, Head of the Hylebos Waterway Problem Area, Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington, Prepared for Head of Hylebos Cleanup Group, August.

DOF. 2013. Final Remedial Investigation Report for Former Arkema Manufacturing Plant, 2901 & 2920 Taylor Way, Tacoma, Washington, Prepared for Port of Tacoma, September.

DOF. 2015a. As-Built Report, 2013 Interim Action, 3009 Taylor Way Interim Action, Prepared for Port of Tacoma, April 6.

DOF. 2015b. Interim Action Construction Report Wypenn Property Tacoma, Washington, Prepared for Port of Tacoma, January.

Ecology. 1994. Natural Background Soil Metals Concentrations in Washington State, Publication No. 94-115. October.

Ecology. 2001a. Memorandum from Pete Kmet to Interested Persons with the subject of “Calculations for Table 740-1; Method A Soil Cleanup Levels for Unrestricted Land Uses”, February 9.

Ecology. 2001b. Memorandum from Pete Kmet to Interested Persons with the subject of “Calculations for Table 745-1; Method A Soil Cleanup Levels for Commercial/Industrial Land Uses”, February 9.

Ecology. 2013. Email from Dominick Reale to Matt Dalton with a subject of "RE: Arkema Draft RI - Revised Exec Summary," September 9.

Ecology. 2016. Email from Joyce Mercuri to Pamela Morrill, Terry Hall, Nizar Hindi, and Scott Hooton with a subject of "RE: USG Tacoma Supplemental RI," October 11.

Ecology. 2020. Toxics Cleanup Program’s Cleanup Levels and Risk Calculations database, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx, accessed September.

Ecology. 2021. Letter from Joyce Mercuri to Nizar Hindi and Scott Hooton with a subject of "Re: Agreed Order No. DE 3405: Expansion of scope for Remedial Actions at the USG Taylor Way Plant Site (Cleanup Site ID #5003), under Agreed Order No. DE 3405, to include contamination within the North Boundary Area," January 13.

Ecology. 2022. Natural Background Groundwater Arsenic Concentrations in Washington State - Study Results, Publication No. 14-09-044, January.

Fayet-Moore, Flavia et al. 2020. An Analysis of the Mineral Composition of Pink Salt Available in Australia, Foods, October, 9(10): 1490.

Geomedia. 1995. Technical Memorandum: Arsenic Levels & Ground-Water Flow Directions near the Salt Pads, Prepared for ELF Atochem North America, June 26.

Hwang, In Min et al. 2021. Determination of Toxic Elements and Arsenic Species in Salted Foods and Sea Salt by ICP-MS and HPLC-ICP-MS, ACS Omega, Volume 6, Issue 50, pp. 19427-19434.

Kennedy/Jenks Consultants. 2002. Phase I and Limited Phase II Environmental Site Assessment, Thermafiber Site, Prepared for Port of Tacoma, December 6.

Kennedy/Jenks/Chilton. 1990. Sampling and Analysis Program Report, ATOCHEM Tacoma Plant, Prepared for ATOCHEM-North America, February.

Malcolm Pirnie. 2006. Evaluation of Media and Chemicals of Potential Concern, Exposure Pathways, and Clean Up Standards – Part 1 Arkema, Inc., Former Inorganic Chemical Plant Tacoma, Washington, Prepared for Legacy Site Services LLC, July.

Malcolm Pirnie. 2007. Soil Data Summary Report, Former Arkema Inorganic Chemical Plant, Prepared for Port of Tacoma, October.

Pacific Environmental & Redevelopment Corporation and PIONEER. 2013. Memo from Brad Grimsted and Jeff King to Scott Hooton titled "All Forensic Data for Port of Tacoma," December 9.

Pennsylvania Department of Environmental Protection. 2011. Chemical Analysis of Major Constituents and Trace Contaminants of Rock Salt.

PIONEER. 2015. Presentation to Ecology titled "Discuss Approach for Preliminary Cleanup Standards, Port of Tacoma Arkema Site." August.

PIONEER. 2017. Cost Allocation Report, North Boundary Area of the Former Arkema Manufacturing Site, Prepared for Port of Tacoma, July.

PIONEER. 2019. Feasibility Study Data Gap Investigation Report, Former Arkema Manufacturing Site, Prepared for Port of Tacoma, July.

PIONEER. 2022. 2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations, Prepared for Port of Tacoma, August 25.

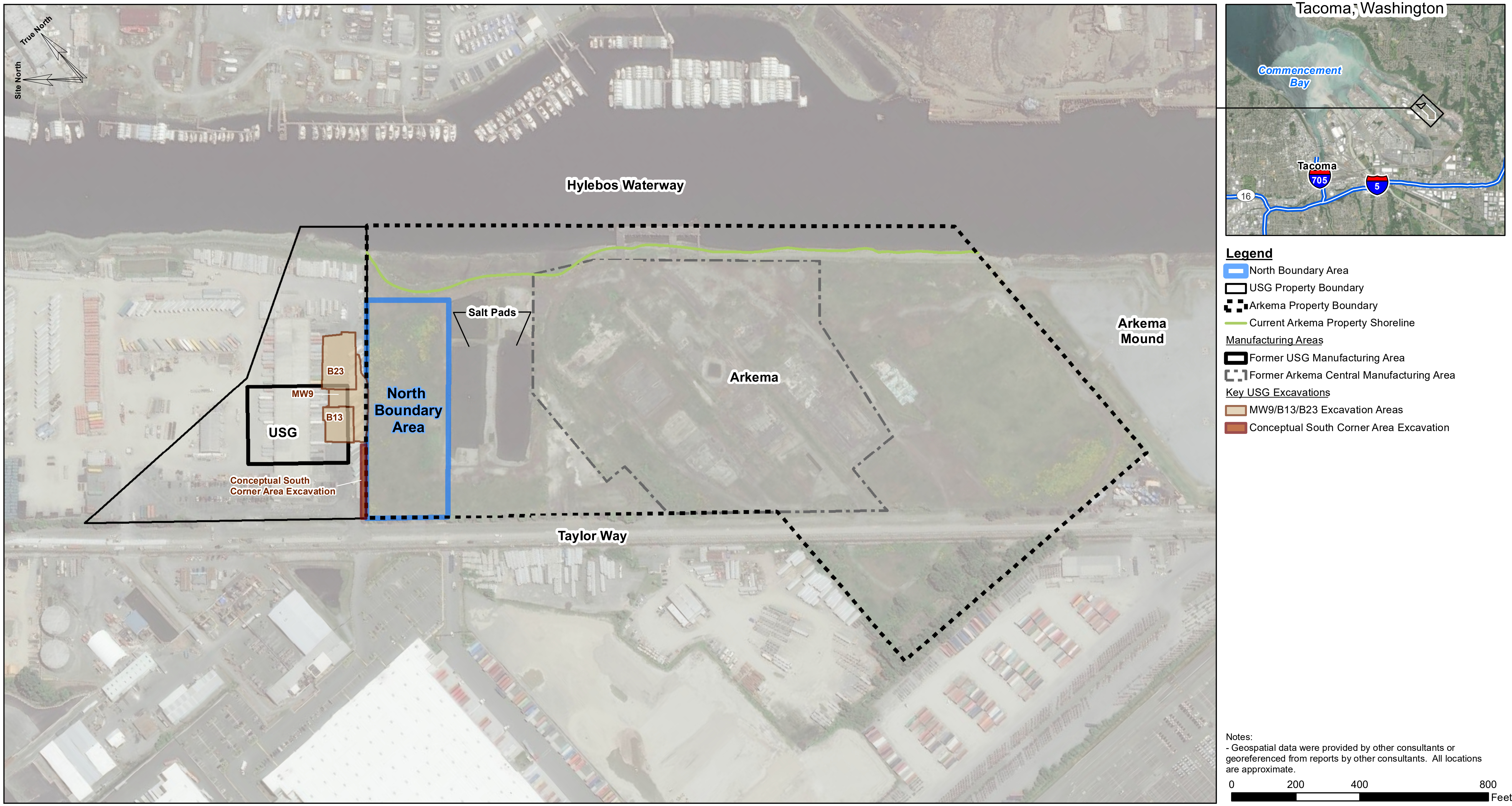
Port. 2014. Land Use & Transportation Plan 2014, June.

Salbu, Brit and Eiliv Steinnes. 1995. Trace Elements in Natural Waters, CRC Press, pp. 255-256.

TLI Systems. 1996. Hylebos Waterway Allocation, Parcel 24, 2301 Taylor Way, May 7.

Western Regional Climate Center. 2016. Climate Summary for Tacoma 1 Station (458278) between 1982 and 2005, http://www.wrcc.dri.edu, accessed July.

Figures



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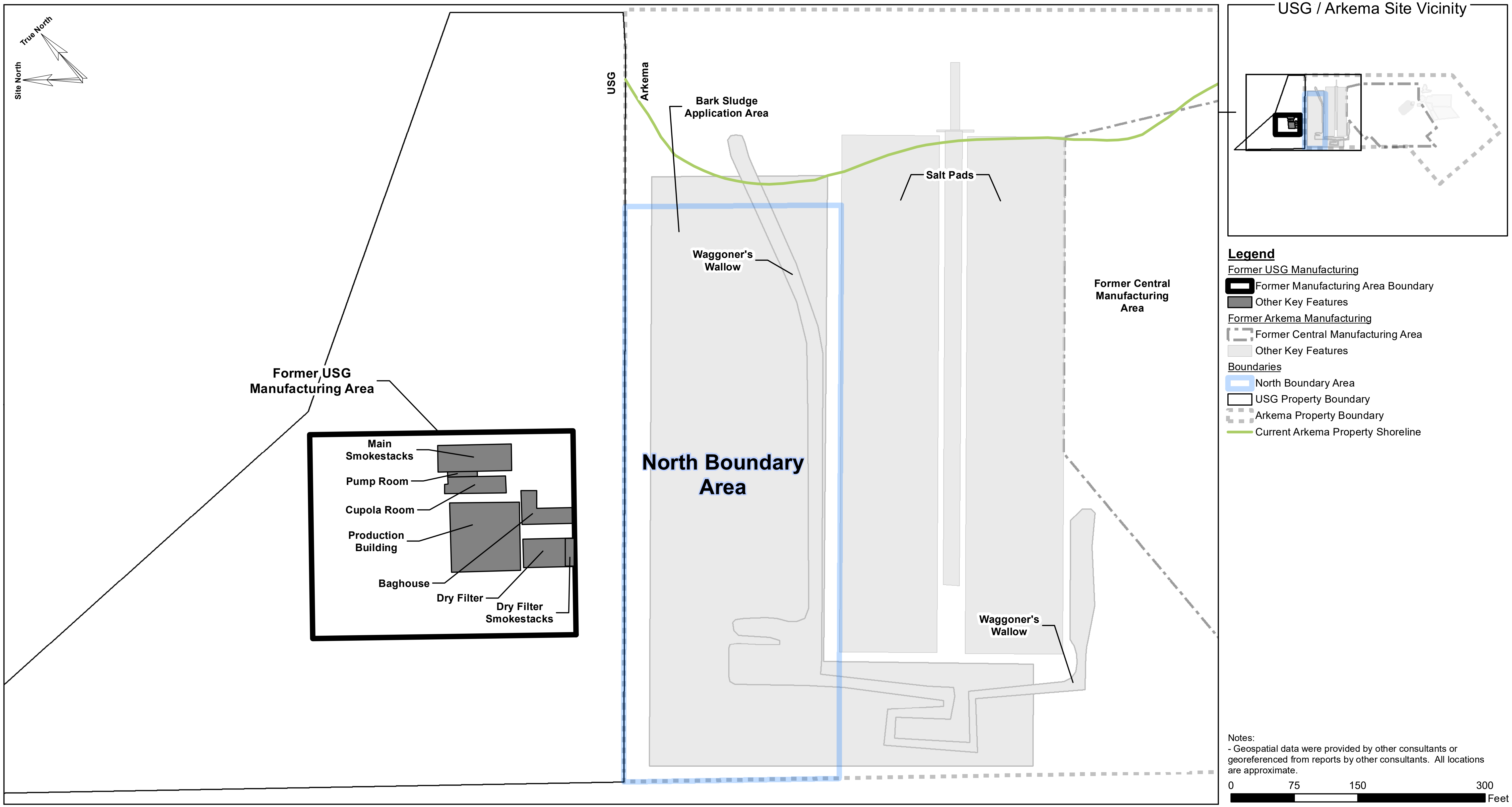
Vicinity Map
NBA Focused FS Report

Figure 1-1

Document Path: G:\Projects\Arkema\Maps\NBA FS Report Dec 2021\Fig 1-1_Vicinity Map.mxd; Author: VN; Date Saved: 12/7/2021



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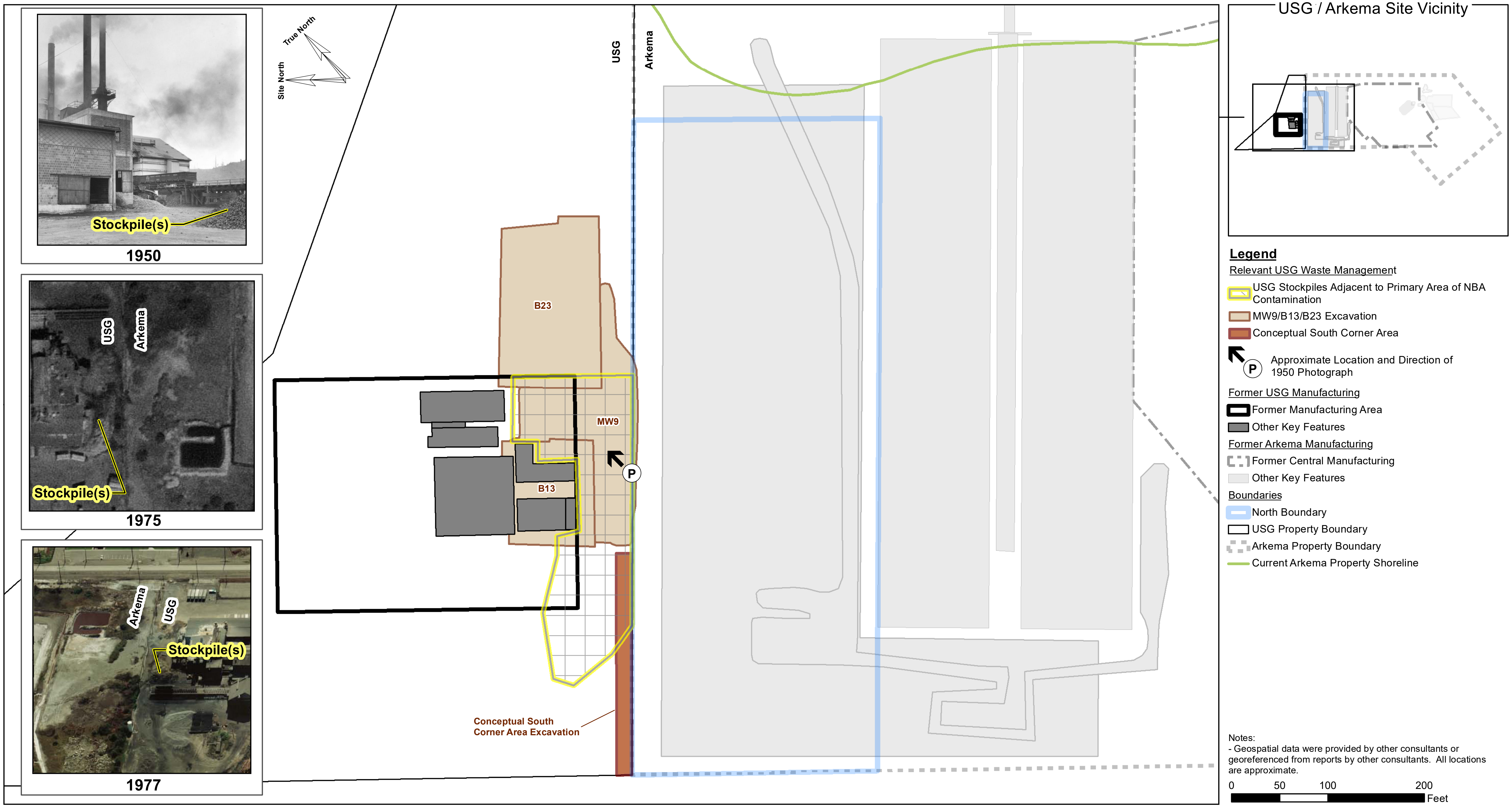
Key Historical Manufacturing Features
NBA Focused FS Report

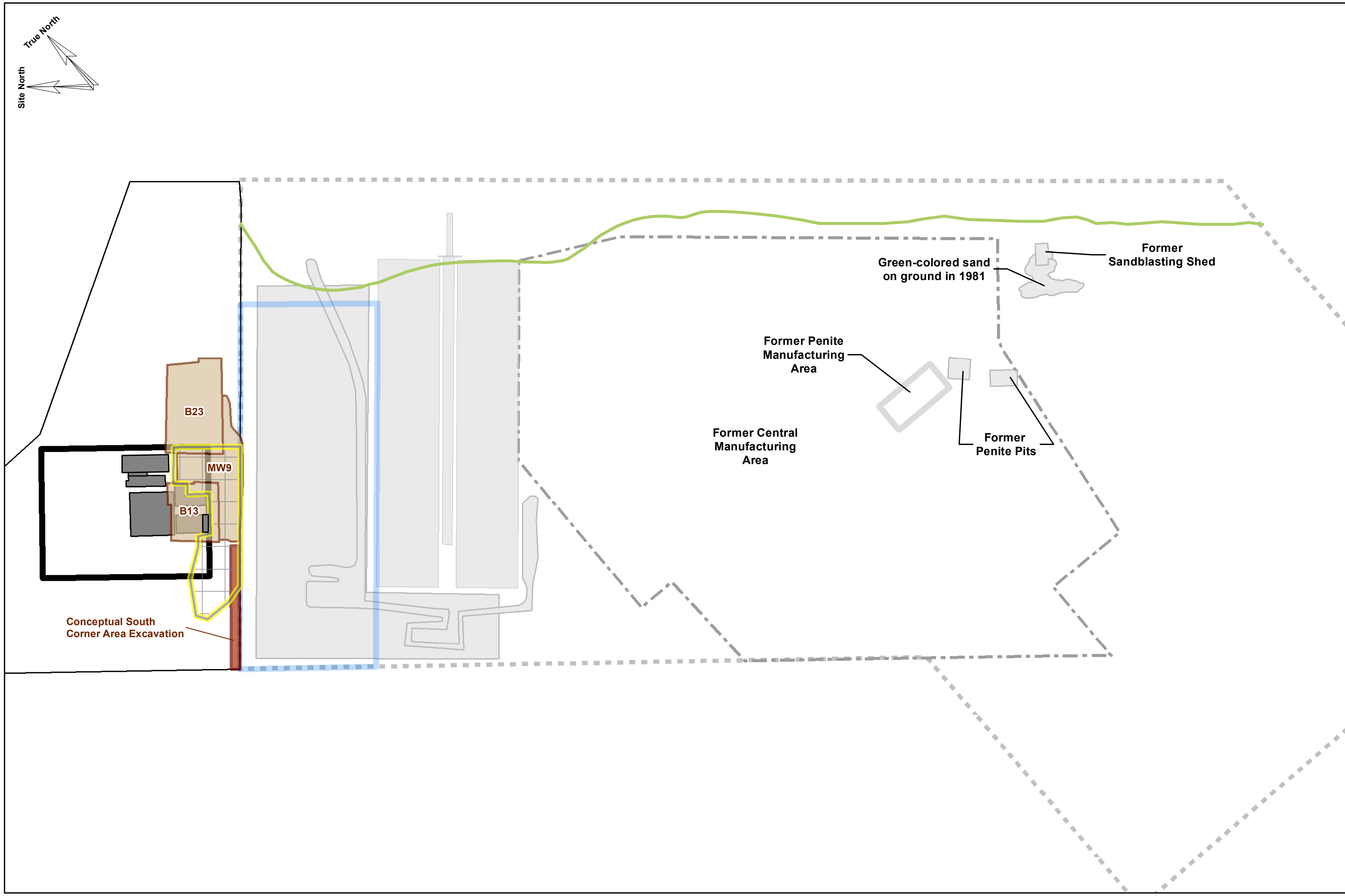
Figure 2-1



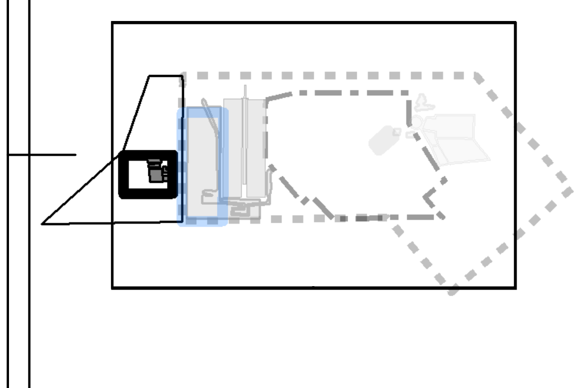
PIONEER TECHNOLOGIES CORPORATION

USG Waste Management Adjacent to the NBA
NBA Focused FS Report

Figure 2-2



USG / Arkema Site Vicinity



Legend

Relevant USG Waste Management Activities
- USG Stockpiles Adjacent to Primary Area of NBA Contamination
- MW9/B13/B23 Excavation Areas
- Conceptual South Corner Area Excavation

Former USG Manufacturing
- Former Manufacturing Area Boundary
- Other Key Features

Former Arkema Manufacturing
- Former Central Manufacturing Area
- Other Key Features

Boundaries
- North Boundary Area
- USG Property Boundary
- Arkema Property Boundary
- Current Arkema Property Shoreline

Notes:
- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

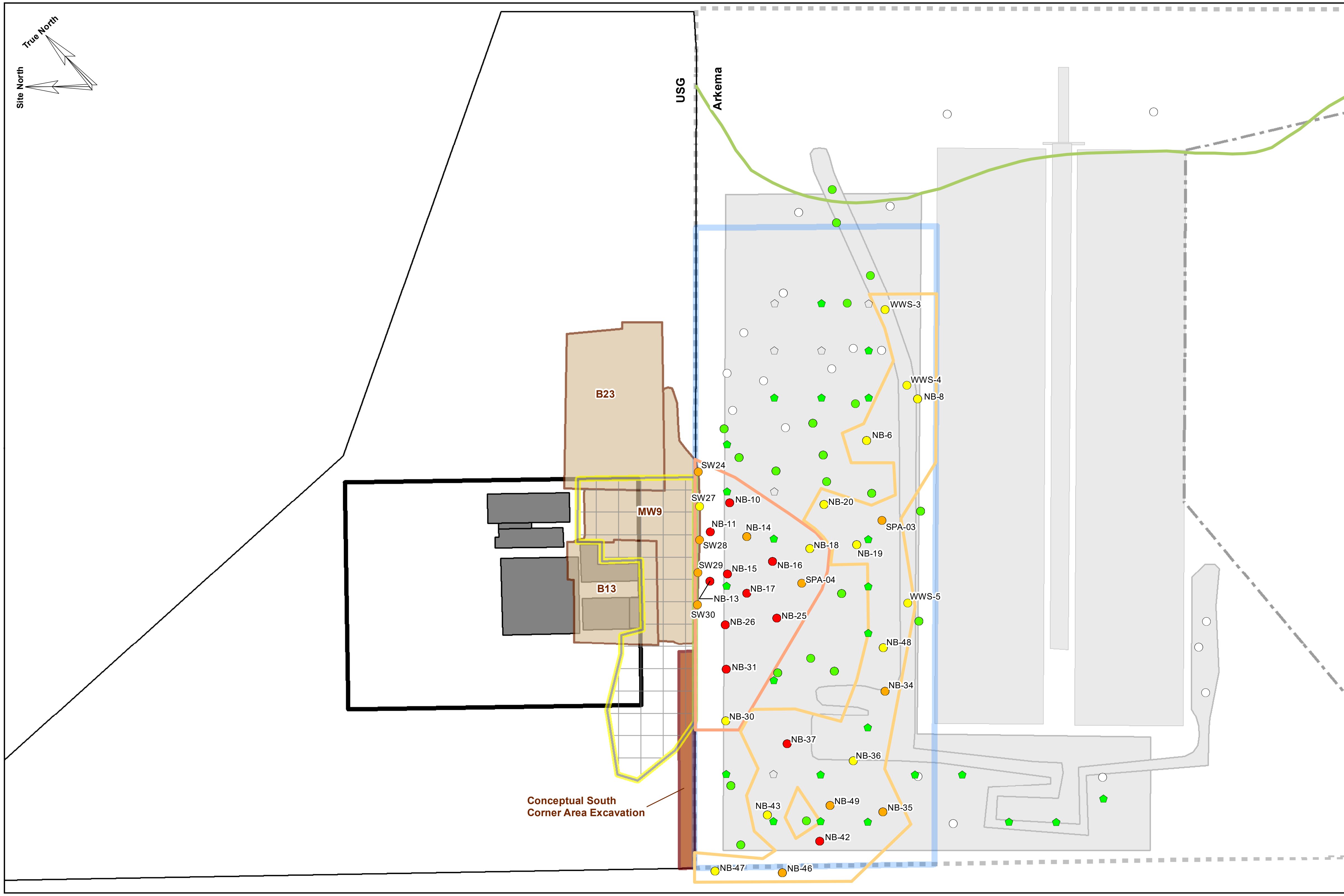
0 75 150 300 Feet

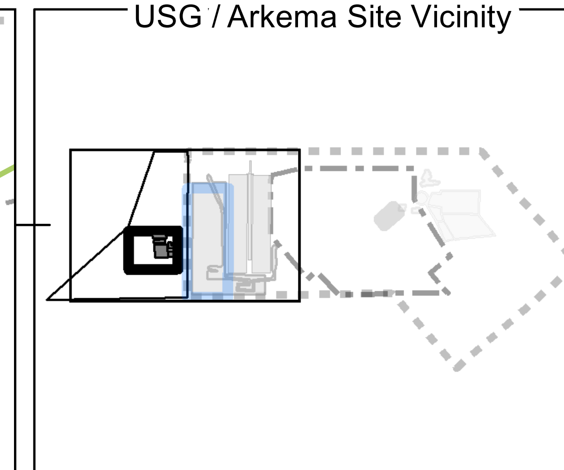
PIONEER TECHNOLOGIES CORPORATION

Locations of Arkema Arsenic Features Relative to the NBA
NBA Focused FS Report

Figure 2-3

Document Path: G:\Projects\Arkema\Maps\NBA FS Report Dec 2021\Fig 2-3_Arkema Arsenic Features relative to NBA.mxd; Author: SM; Date Saved: 12/15/2021





Legend

Soil Sample Type
- All Soil Samples Other Than Bark Sludge
- Bark Sludge Samples

Maximum Arsenic Concentration in Borings Between 0-15 feet bgs
- Arsenic ≤ 20 mg/kg
- 20 mg/kg < Arsenic ≤ 88 mg/kg
- 88 mg/kg < Arsenic ≤ 400 mg/kg
- 400 mg/kg < Arsenic ≤ 1,060 mg/kg
- Arsenic > 1,060 mg/kg

Relevant USG Waste Management Activities
- USG Stockpiles Adjacent to Primary Area of NBA Contamination
- MW9/B13/B23 Excavation Areas
- Conceptual South Corner Area Excavation

Former USG Manufacturing
- Former Manufacturing Area Boundary
- Other Key Features

Former Arkema Manufacturing
- Former Central Manufacturing Area
- Other Key Features

Boundaries
- North Boundary Area
- USG Property Boundary
- Arkema Property Boundary
- Primary Area of Arsenic and Lead Contamination
- Secondary Area of Arsenic and Lead Contamination
- Current Arkema Property Shoreline

Notes:
- The maximum concentration at each boring is shown, regardless of sample depth or the analytical method used (lab or XRF).
- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

0 75 150 300 Feet

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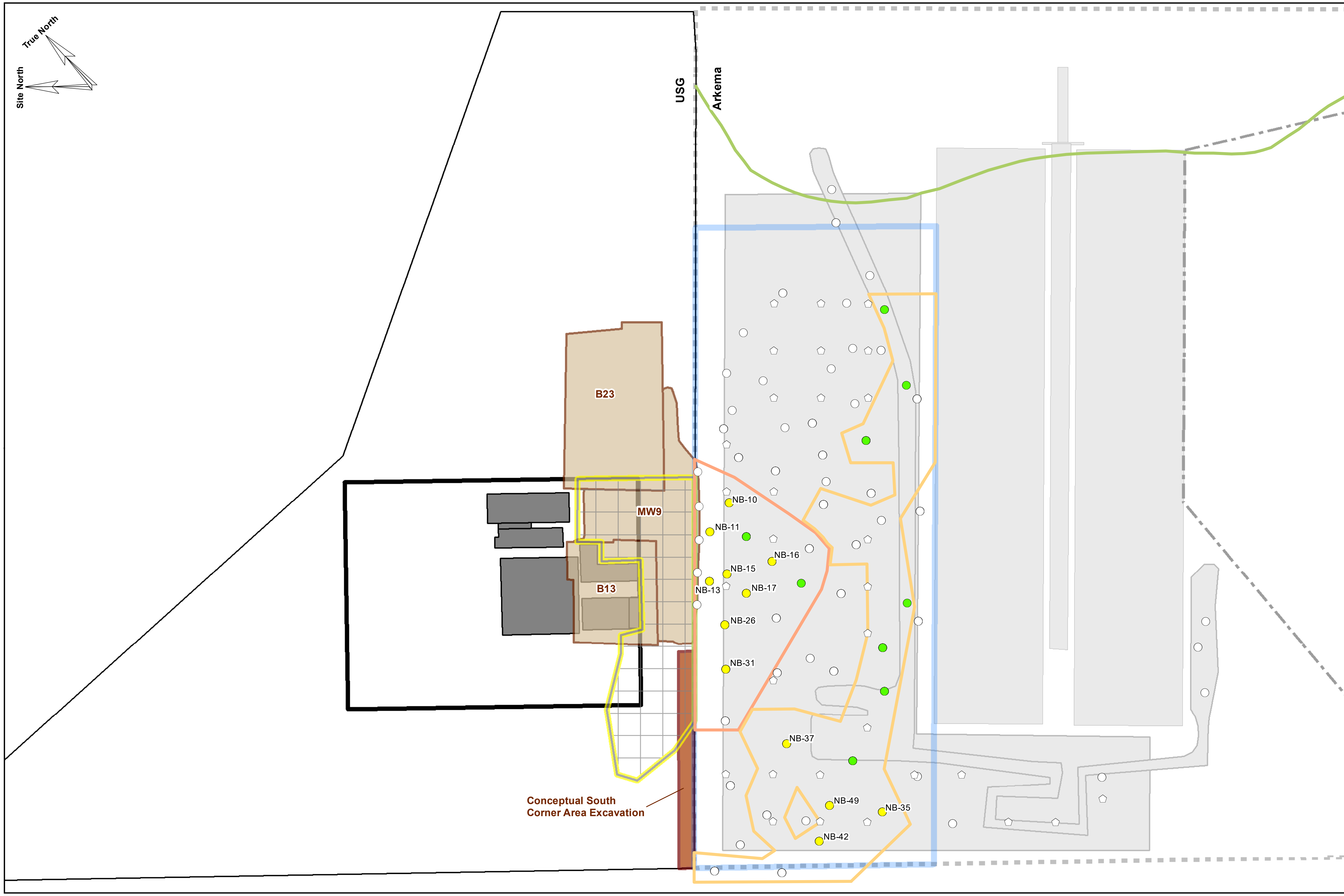
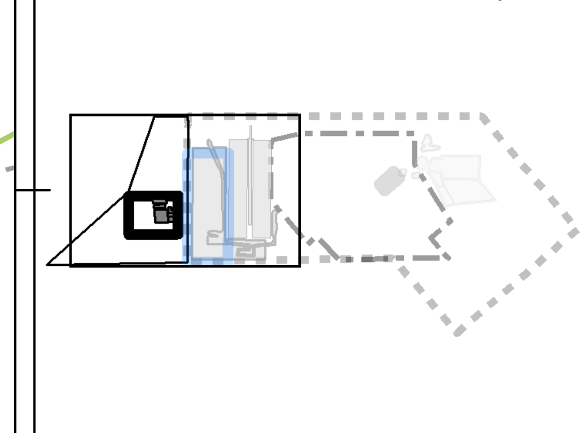
Summary of Arsenic Soil Concentrations
NBA Focused FS Report

Figure 2-4A





Legend

Soil Sample Type
- All Soil Samples Other Than Bark Sludge
- Bark Sludge Samples

Maximum Lead Concentration in Borings Between 0-15 feet bgs
- Lead ≤ 250 mg/kg
- 250 mg/kg < Lead ≤ 1,000 mg/kg
- Lead > 1,000 mg/kg

Relevant USG Waste Management
- USG Stockpiles Adjacent to Primary Area of NBA Contamination
- MW9/B13/B23 Excavation
- Conceptual South Corner Area Excavation

Former USG Manufacturing
- Former Manufacturing Area
- Other Key Features

Former Arkema Manufacturing
- Former Central Manufacturing
- Other Key Features

Boundaries
- North Boundary
- USG Property Boundary
- Arkema Property Boundary
- Primary Area of Arsenic and Lead Contamination
- Secondary Area of Arsenic and Lead Contamination
- Current Arkema Property Shoreline

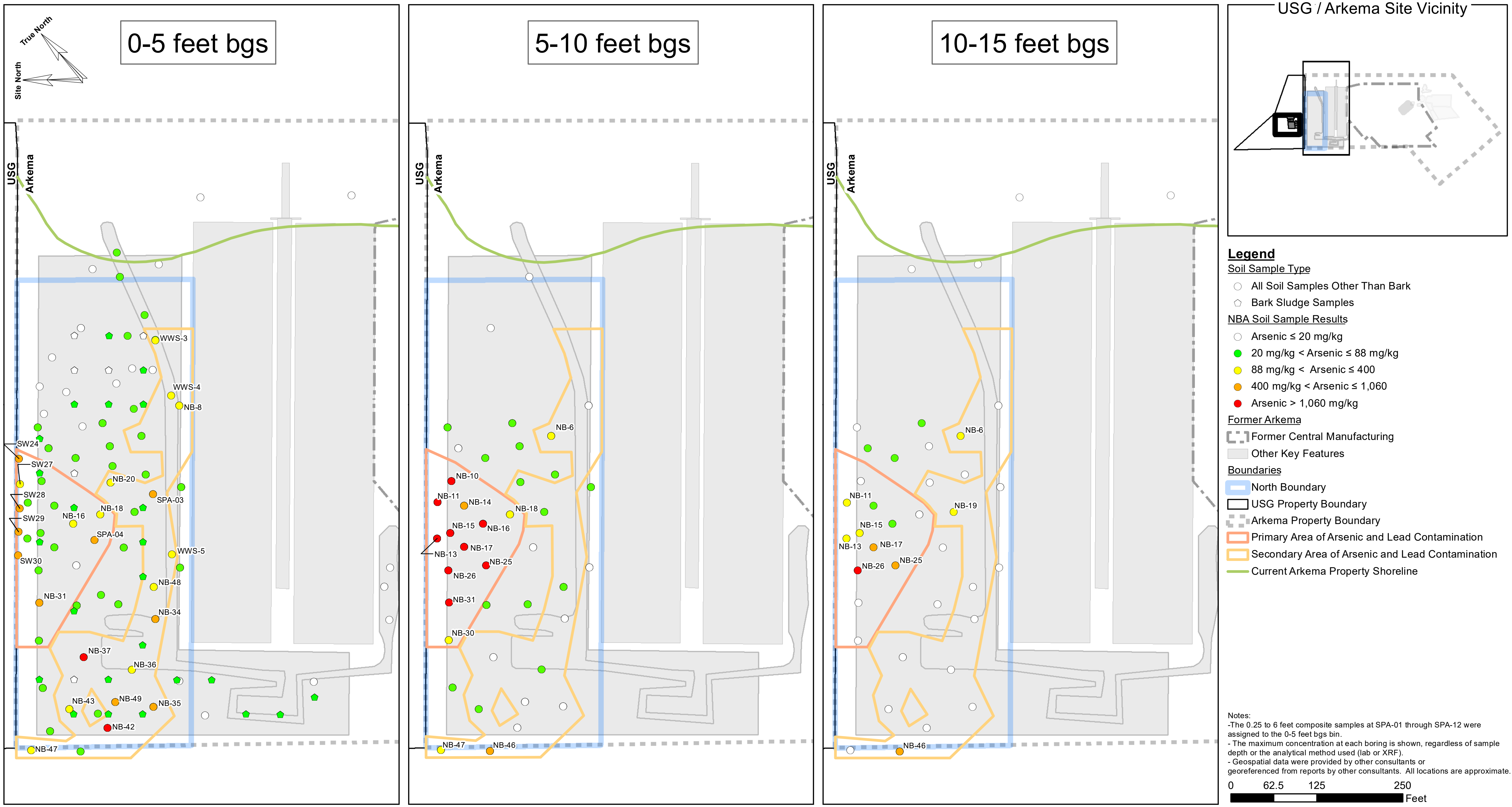
Notes:
- The maximum concentration at each boring is shown, regardless of sample depth or the analytical method used (lab or XRF).
- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

0 75 150 300 Feet

PIONEER TECHNOLOGIES CORPORATION

Summary of Lead Soil Concentrations
NBA Focused FS Report

Figure 2-4B



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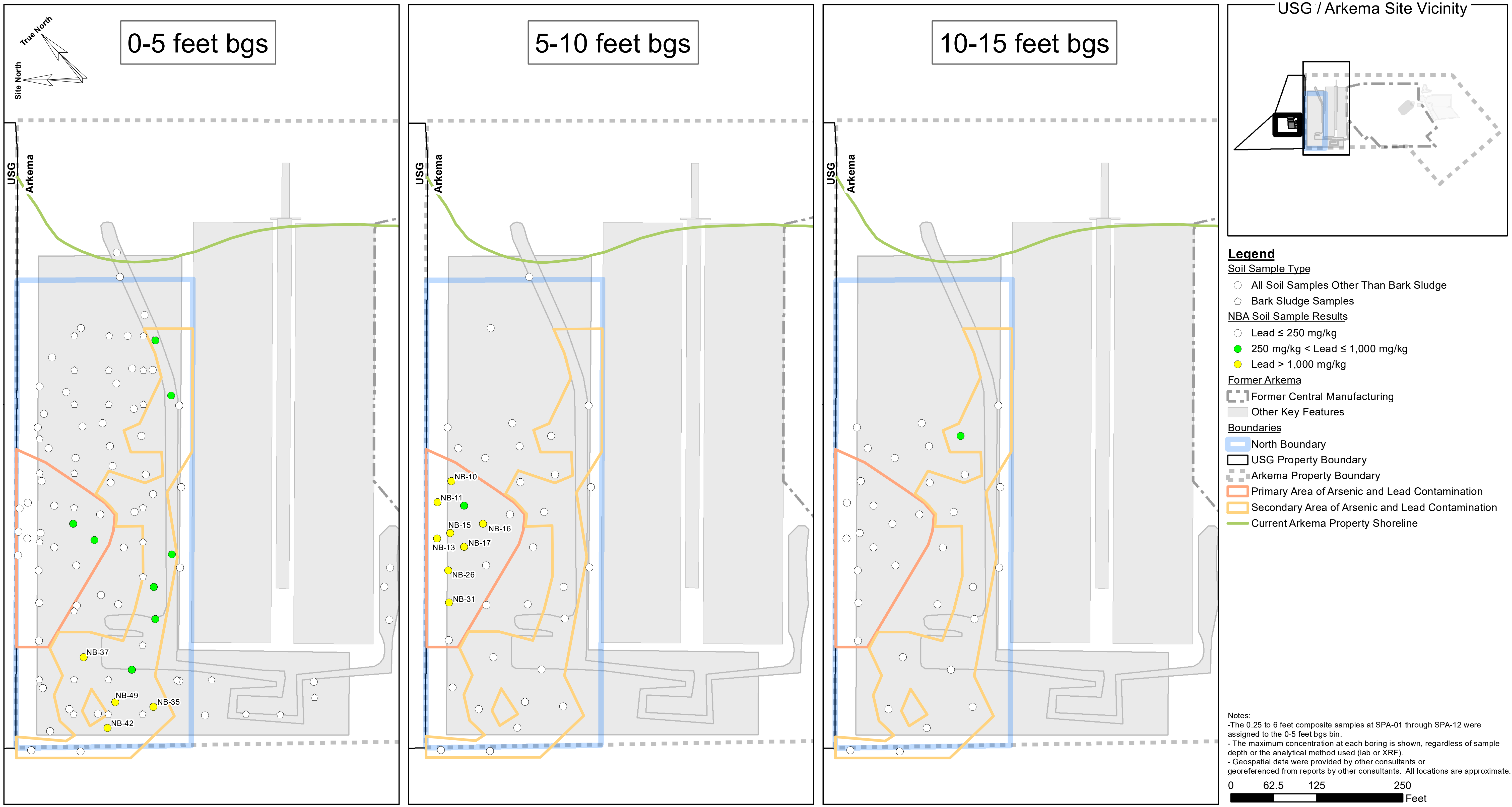
Arsenic Soil Concentrations by Depth
NBA Focused FS Report

Figure 2-5A



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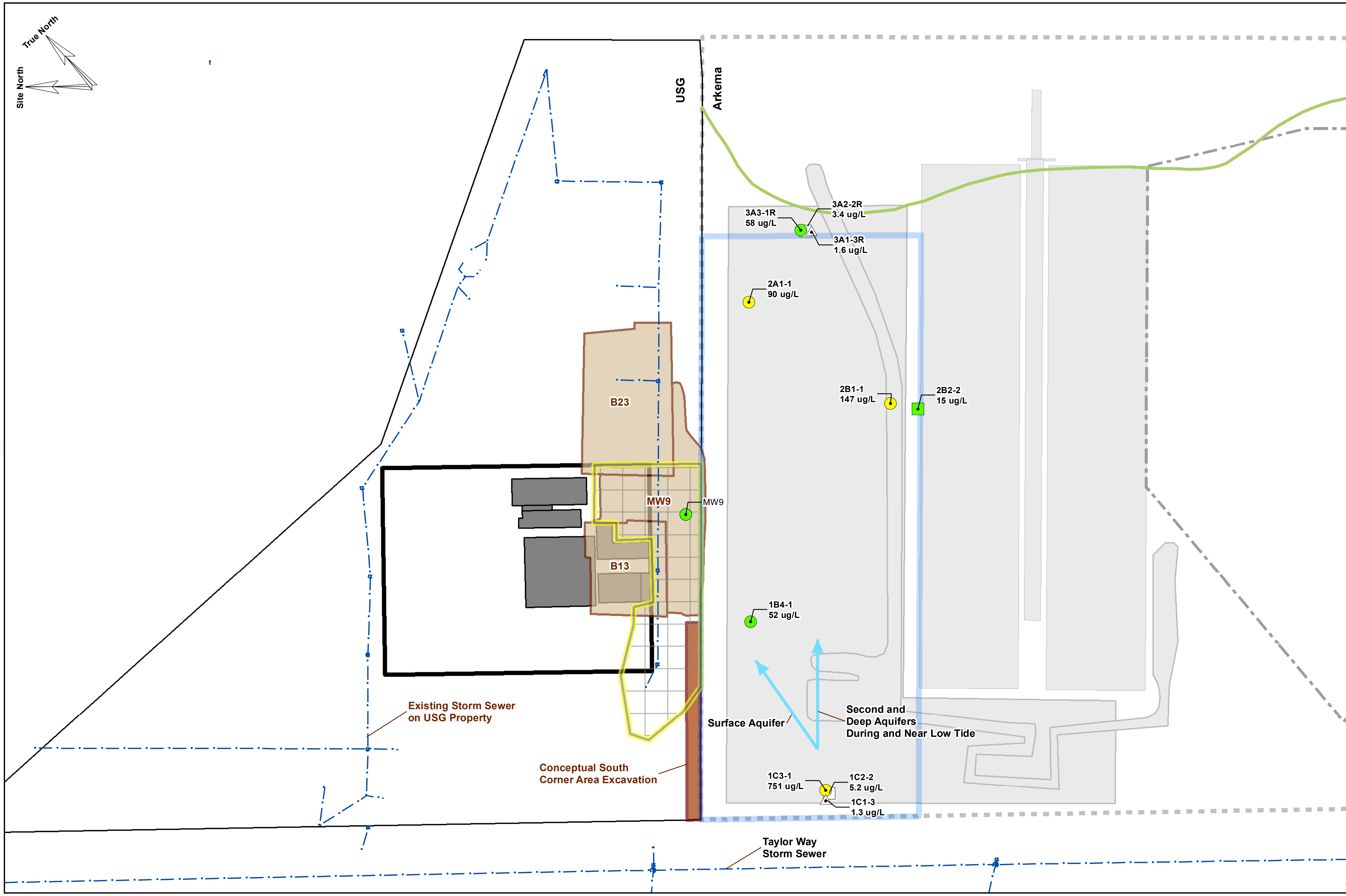
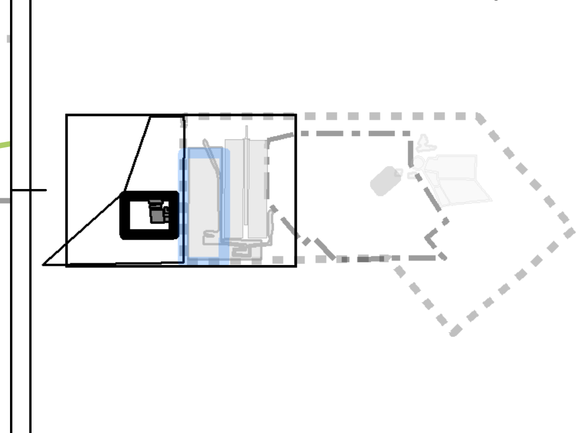
Lead Soil Concentrations by Depth
NBA Focused FS Report

Figure 2-5B



USG / Arkema Site Vicinity



Legend

Aquifer Designation
- Surface Aquifer
- Second Aquifer
- Deep Aquifer

2017 Dissolved Arsenic Groundwater Concentrations
- Dissolved Arsenic ≤ 8 ug/L (or Not
- 8 ug/L < Dissolved Arsenic ≤ 80 ug/L
- 80 ug/L < Dissolved Arsenic ≤ 800 ug/L
- Dissolved Arsenic > 800 ug/L

Relevant USG Waste Management Activities
- USG Stockpiles Adjacent to Primary Area of NBA Contamination
- MW9/B13/B23 Excavation Areas
- Conceptual South Corner Area Excavation

Former USG Manufacturing
- Former Manufacturing Area Boundary
- Other Key Features

Former Arkema Manufacturing
- Former Central Manufacturing Area
- Other Key Features

Boundaries
- North Boundary Area
- USG Property Boundary
- Arkema Property Boundary
- Current Arkema Property Shoreline

Other Features
- General Groundwater Flow Direction (see Appendix A)
- Storm Sewer

Notes:
- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

0 75 150 300 Feet

PIONEER TECHNOLOGIES CORPORATION

2017 Dissolved Arsenic Groundwater Concentrations
NBA Focused FS Report

Figure 2-6

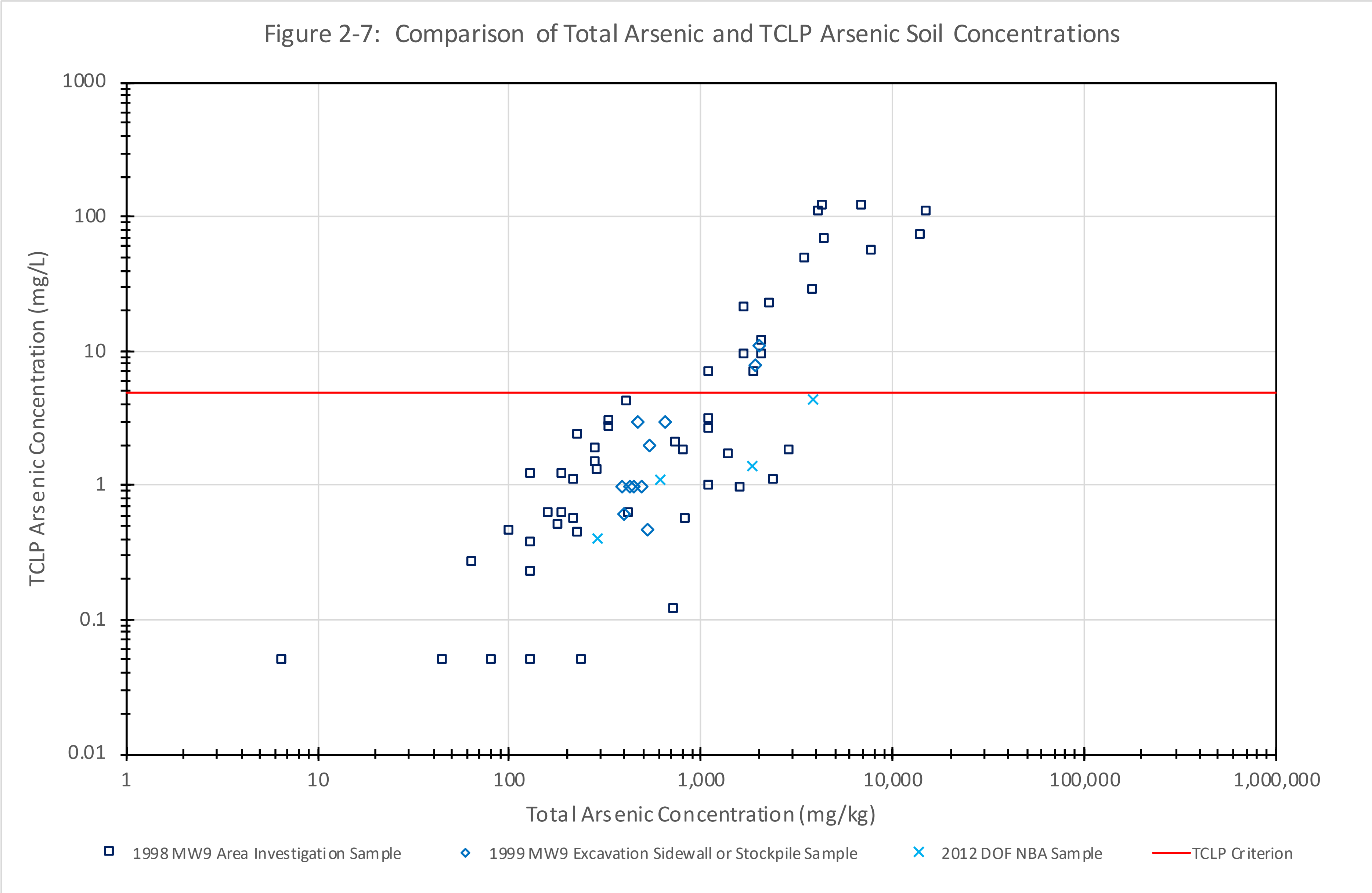
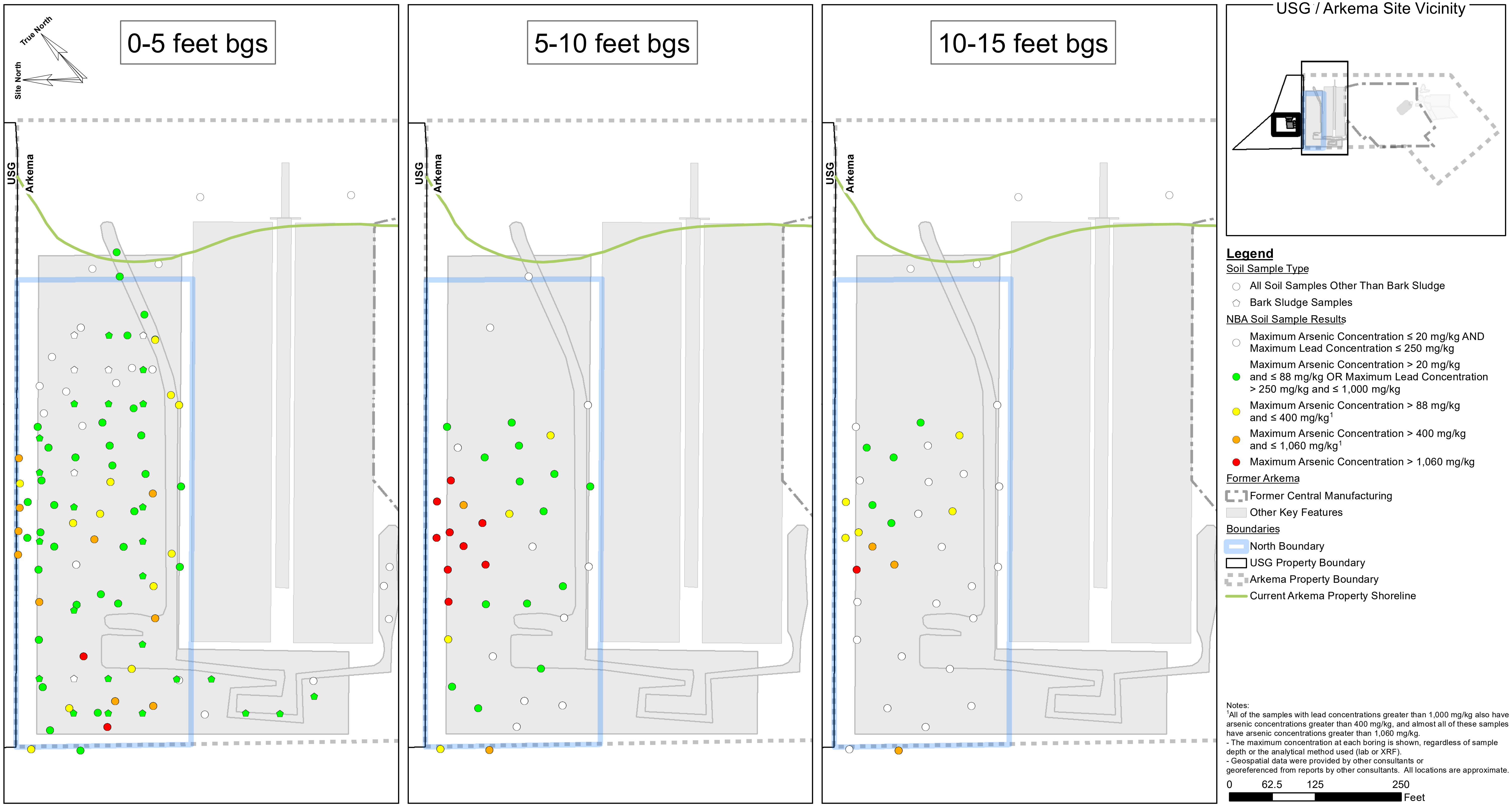


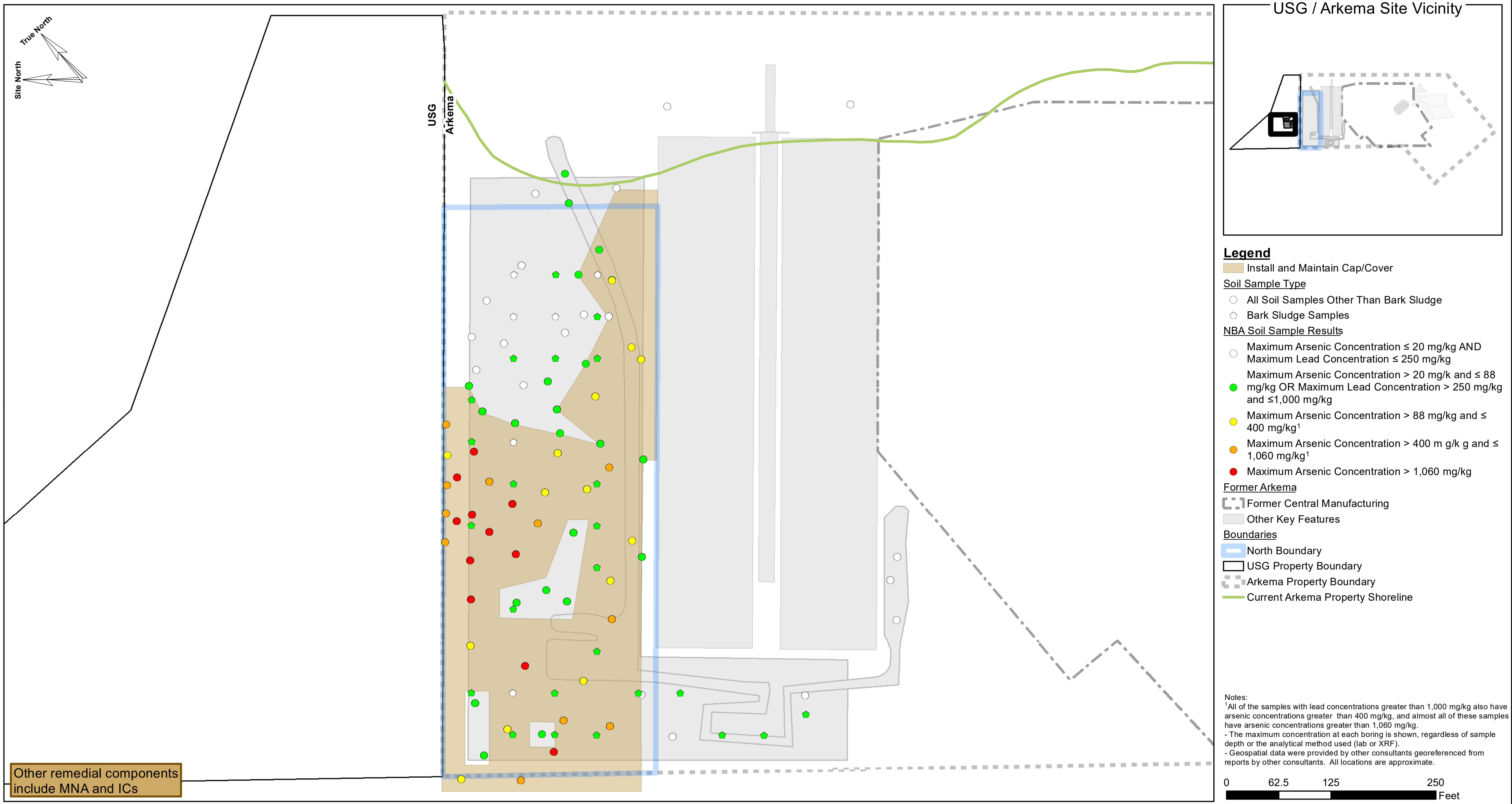
Figure 2-7: Comparison of Total Arsenic and TCLP Arsenic Soil Concentrations
1000
100
10
1
0.1
0.01
TCLP Arsenic Concentration (mg/L)
1
10
100
1,000
10,000
100,000
1,000,000
Total Arsenic Concentration (mg/kg)
1998 MW9 Area Investigation Sample
1999 MW9 Excavation Sidewall or Stockpile Sample
2012 DOF NBA Sample
TCLP Criterion



PIONEER TECHNOLOGIES CORPORATION

Summary of Soil Exceedances for Arsenic and Lead
NBA Focused FS Report

Figure 3-1



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Alternative 1 – Cap/Cover, MNA, and ICs
NBA Focused FS Report

Figure 5-1

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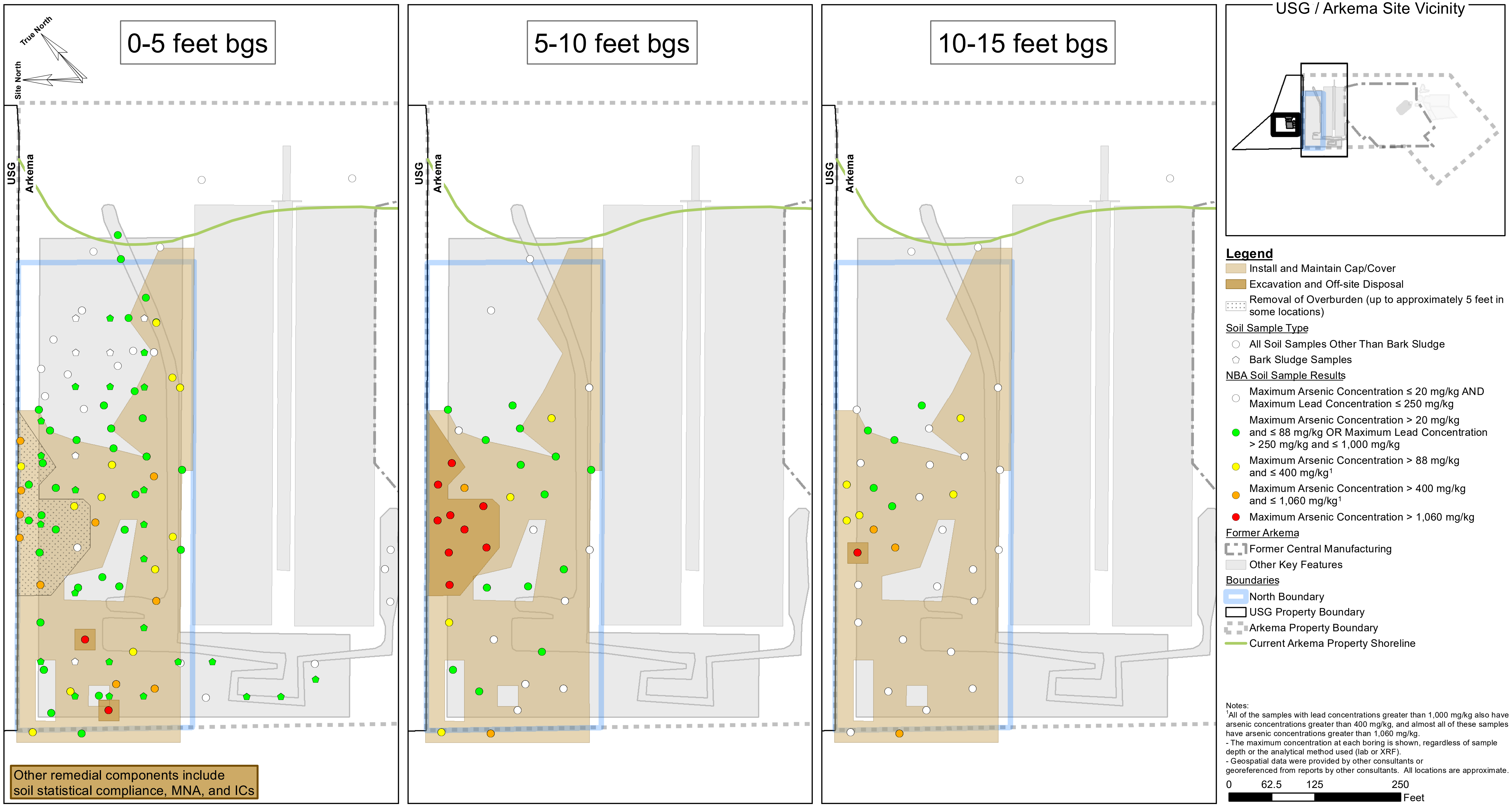
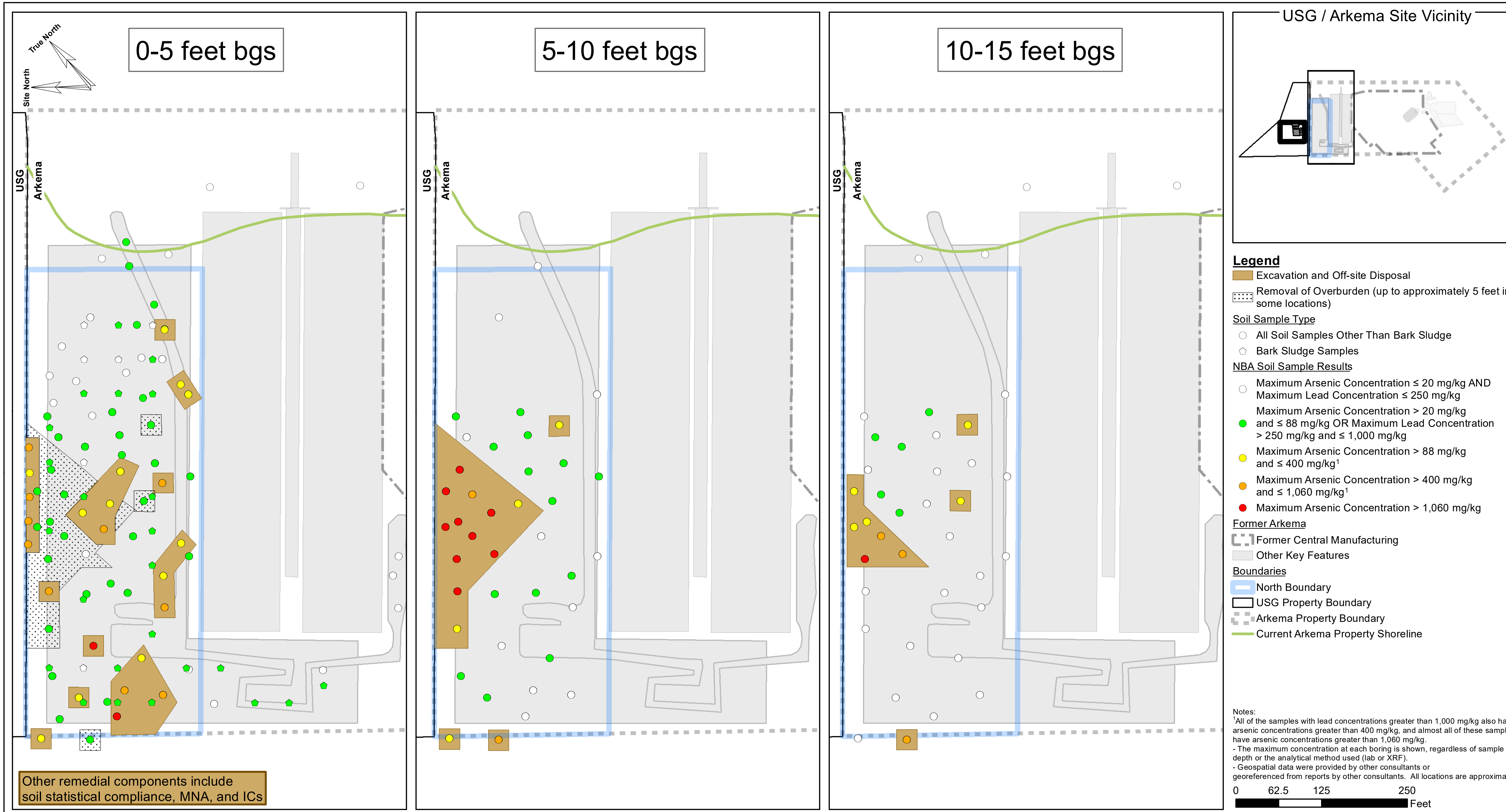


PIONEER TECHNOLOGIES CORPORATION

Alternative 2 – Excavate RLs, Cap/Cover, MNA, and ICs
NBA Focused FS Report

Figure 5-2



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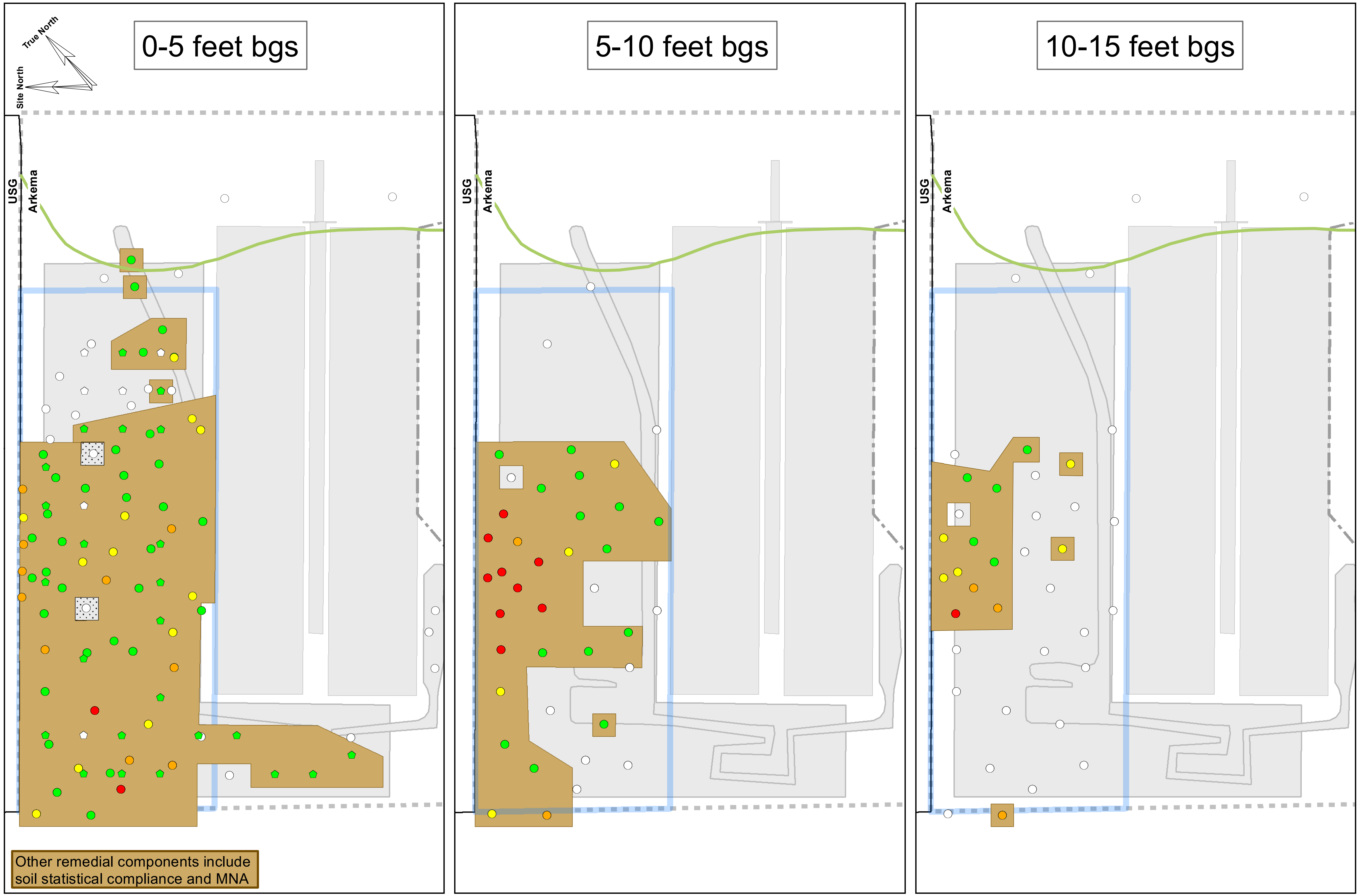
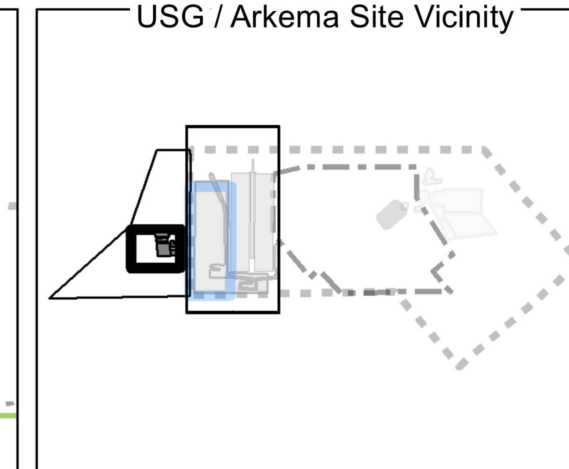
Alternative 3 – Excavate Industrial CLs, MNA, and ICs
NBA Focused FS Report

Figure 5-3





Legend

Excavation and Off-site Disposal

Removal of Overburden (up to approximately 5 feet in some locations)

Soil Sample Type

- All Soil Samples Other Than Bark Sludge
- Bark Sludge Samples

NBA Soil Sample Results

- Maximum Arsenic Concentration ≤ 20 mg/kg AND Maximum Lead Concentration ≤ 250 mg/kg
- Maximum Arsenic Concentration > 20 mg/kg and ≤ 88 mg/kg OR Maximum Lead Concentration > 250 mg/kg and ≤ 1,000 mg/kg
- Maximum Arsenic Concentration > 88 mg/kg and ≤ 400 mg/kg[1]
- Maximum Arsenic Concentration > 400 mg/kg and ≤ 1,060 mg/kg[1]
- Maximum Arsenic Concentration > 1,060 mg/kg

Former Arkema

- Former Central Manufacturing
- Other Key Features

Boundaries

- North Boundary
- USG Property Boundary
- Arkema Property Boundary
- Current Arkema Property Shoreline

Notes:

[1]All of the samples with lead concentrations greater than 1,000 mg/kg also have arsenic concentrations greater than 400 mg/kg, and almost all of these samples have arsenic concentrations greater than 1,060 mg/kg.

- The maximum concentration at each boring is shown, regardless of sample depth or the analytical method used (lab or XRF).
- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

0 62.5 125 250 Feet

Document Path: G:\Projects\Arkema\Maps\NBA FS Report Dec 2021\Fig 5-4 CAA 4.mxd; Author: VN; Date Saved: 2/28/2023

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Alternative 4 – Excavate Unrestricted CLs and MNA
NBA Focused FS Report

Figure 5-4

Tables

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Table 2-1: Soil Screening Levels

Constituent	Standard Method B Soil Value for Carcinogens [(1)] (mg/kg)	Standard Method B Soil Value for Non-carcinogens [(1)] (mg/kg)	Soil Direct Contact Screening Level for Unrestricted Land Use [(2)] (mg/kg)	Standard Method C Soil Value for Carcinogens [(1)] (mg/kg)	Standard Method C Soil Value for Non-carcinogens [(1)] (mg/kg)	Soil Direct Contact Screening Level for Industrial Land Use [(2)] (mg/kg)
Arsenic	0.67	24	20 [(3)]	88	1,100	88
Lead	--	--	250 [(4)]	--	--	1,000 [(4)]
Copper	--	3,200	3,200	--	140,000	140,000
Mercury	--	24 [(5)]	24		1,050 [(5)]	1,050
Nickel	--	1,600	1,600	--	70,000	70,000

Notes:

--: No value exists for this constituent in the CLARC database (Ecology 2020).

All values are presented as two significant figures in standard notation.

(1) Values from CLARC (Ecology 2020), unless otherwise noted.

(2) The screening level is the most stringent of the carcinogenic and non-carcinogenic values.

(3) Adjusted to accepted soil background concentration of 20 mg/kg per WAC 173-340-740(5)(c) (see MTCA Table 740-1 footnote b).

(4) MTCA Method A soil cleanup levels were used for lead because there are not MTCA Method B or Method C values for lead.

(5) Default direct contact values for an unrestricted land use scenario (Ecology 2001a) and an industrial land use scenario (Ecology 2001b).

Table 2-2: Groundwater Screening Levels

Constituent	Standard Method B Surface Water Value for Carcinogens [1] (ug/L)	Standard Method B Surface Water Value for Non-Carcinogens [1] (ug/L)	Surface Water Value for Acute Marine Aquatic Life 173-201A WAC [1] (ug/L)	Surface Water Value for Acute Marine Aquatic Life CWA §304 [1] (ug/L)	Surface Water Value for Chronic Marine Aquatic Life 173-201A WAC [1] (ug/L)	Surface Water Value for Chronic Marine Aquatic Life CWA §304 [1] (ug/L)	Surface Water Value for Human Health in Marine Waters 173-201A WAC [1] (ug/L)	Surface Water Value for Human Health in Marine Waters 40 CFR 131.45 [1] (ug/L)	Surface Water Value for Human Health in Marine Waters CWA §304 [1] (ug/L)	SL [2] (ug/L)
Arsenic	0.098	18	69	69	36	36	10.0	0.14	0.14	8.0 [3]
Copper	--	2,900	4.8	4.8	3.1	3.1	--	--	--	3.1
Mercury	--	--	1.8	1.8	0.025	0.94	--	--	--	0.025
Nickel	--	1,100	74	74	8.2	8.2	190	100	4600	8.2

Notes:

--: No value exists for this constituent in the CLARC database (Ecology 2020).

All values are presented as two significant figures in standard notation.

[1] Values from CLARC (Ecology 2020), unless otherwise noted.

[2] The screening level is the most stringent of all criteria in this table, subject to necessary adjustments in accordance with WAC 173-340-730(5)(c).

[3] Adjusted to the Puget Sound Basin groundwater background concentration of 8 ug/L (Ecology 2022) in accordance with WAC 173-340-720(7)(c).

Table 2-3: Comparison of Maximum COPC Concentrations and SLs

Constituent	Maximum Soil Concentration in the NBA and Adjacent Areas on the Arkema Property [(1)] (mg/kg)	Soil Direct Contact SL for Unrestricted Land Use [(2)] (mg/kg)	Maximum Concentration Exceeds Soil Direct Contact SL for Unrestricted Land Use?	Soil Direct Contact SL for Industrial Land Use [(2)] (mg/kg)	Maximum Concentration Exceeds Soil Direct Contact SL for Industrial Land Use?	Maximum Groundwater Concentration in the NBA [(1)] (ug/L)	Groundwater SL [(3)] (ug/L)	Maximum Concentration Exceeds Groundwater SL?	Exceedance Factor [(4)]
Arsenic	4,653	20	Yes	88	Yes	751	8.0	Yes	94
Lead	10,474	250	Yes	1,000	Yes	N/A	N/A	N/A	N/A
Copper	683	3,200	No	140,000	No	15	3.1	Yes	4.8
Mercury	0.74	24	No	1,050	No	0.0041	0.025	No	N/A
Nickel	200	1,600	No	70,000	No	18	8.2	Yes	2.2

Notes:

N/A: Not applicable since lead is not a COPC (DOF 2013).

(1) See Table A-1 in Appendix A for soil results. See Table A-2 in Appendix A for groundwater results.

(2) See Table 2-1.

(3) See Table 2-2.

(4) The exceedance factor is the ratio of the maximum groundwater concentration and the groundwater SL.

Table 6-1: MTCA Threshold Requirements Evaluation

MTCA Threshold Requirement	Alternative 1 Cap/Cover, MNA, and ICs		Alternative 2 Excavate RLs, Cap/Cover, MNA, and ICs		Alternative 3 Excavate Industrial CLs, MNA, and ICs		Alternative 4 Excavate Unrestricted CLs and MNA	
	Does the Alternative Satisfy the Requirement?	Rationale	Does the Alternative Satisfy the Requirement?	Rationale	Does the Alternative Satisfy the Requirement?	Rationale	Does the Alternative Satisfy the Requirement?	Rationale
Protect human health and the environment	No	The alternative would not satisfy this requirement because Ecology indicated in its report review comments that the alternative would not satisfy the requirement (due to a lack of any soil excavation).	Yes	The alternative would satisfy this requirement because the alternative would satisfy the CAOs, which were developed to protect human health and the environment under current and future land use scenarios. Specifically, the incidental ingestion of soil pathways would be addressed with soil excavation, the cap/cover, and ICs. Soil excavation and MNA would reduce arsenic concentrations downgradient of the NBA to ensure protection of surface water and sediment receptors (although there is less protection certainty for Alternative 2 compared to Alternatives 3 and 4 due to the limited soil excavation in Alternative 2). In addition, ICs would prevent future residential land use and drinking water use.	Yes	The alternative would satisfy this requirement because the alternative would satisfy the CAOs, which were developed to protect human health and the environment under current and future land use scenarios. Specifically, the incidental ingestion of soil pathways would be addressed with soil excavation. Soil excavation and MNA would reduce arsenic concentrations downgradient of the NBA to ensure protection of surface water and sediment receptors. In addition, ICs would prevent future residential land use and drinking water use.	Yes	The alternative would satisfy this requirement because the alternative would satisfy the CAOs, which were developed to protect human health and the environment under current and future land use scenarios. Specifically, the incidental ingestion of soil pathways would be addressed with soil excavation. Soil excavation and MNA would reduce arsenic concentrations downgradient of the NBA to ensure protection of surface water and sediment receptors.
Comply with cleanup standards	No	The alternative would not satisfy this requirement because Ecology indicated in its report review comments that the alternative would not satisfy the requirement (due to a lack of any soil excavation).	Yes	The alternative would satisfy this requirement because soil and groundwater cleanup standards would be achieved. Soil cleanup standards would be achieved via soil excavation and the cap/cover. The arsenic groundwater cleanup standard would be achieved over time via soil excavation and MNA.	Yes	The alternative would satisfy this requirement because soil and groundwater cleanup standards would be achieved. Soil cleanup standards would be achieved via soil excavation. The arsenic groundwater cleanup standard would be achieved over time via soil excavation and MNA.	Yes	The alternative would satisfy this requirement because soil and groundwater cleanup standards would be achieved. Soil cleanup standards would be achieved via soil excavation. The arsenic groundwater cleanup standard would be achieved over time via soil excavation and MNA.
Comply with applicable state and federal laws	Yes	The alternative has the capability and would be designed to comply with all applicable state and federal laws (see Appendix B).	Yes	The alternative has the capability and would be designed to comply with all applicable state and federal laws (see Appendix B).	Yes	The alternative has the capability and would be designed to comply with all applicable state and federal laws (see Appendix B).	Yes	The alternative has the capability and would be designed to comply with all applicable state and federal laws (see Appendix B).
Provide for compliance monitoring [(1)]	Yes	The alternative would satisfy this requirement because it includes compliance monitoring. Specifically, the alternative would include protection monitoring (i.e., monitoring, controls, and procedures specified in project-specific health and safety plans), performance monitoring (e.g., construction quality control measures and monitoring, periodic groundwater monitoring, monitoring required by a permit or ARAR [see Appendix B]), and confirmational monitoring (e.g., periodic cap/cover monitoring, periodic groundwater monitoring).	Yes	The alternative would satisfy this requirement because it includes compliance monitoring. Specifically, the alternative would include protection monitoring (i.e., monitoring, controls, and procedures specified in project-specific health and safety plans), performance monitoring (e.g., excavation sidewall and bottom sampling, waste characterization sampling, construction quality control measures and monitoring, periodic groundwater monitoring, monitoring required by a permit or ARAR [see Appendix B]), and confirmational monitoring (e.g., periodic cap/cover monitoring, periodic groundwater monitoring).	Yes	The alternative would satisfy this requirement because it includes compliance monitoring. Specifically, the alternative would include protection monitoring (i.e., monitoring, controls, and procedures specified in project-specific health and safety plans), performance monitoring (e.g., excavation sidewall and bottom sampling, waste characterization sampling, construction quality control measures and monitoring, periodic groundwater monitoring, monitoring required by a permit or ARAR [see Appendix B]), and confirmational monitoring (e.g., periodic groundwater monitoring).	Yes	The alternative would satisfy this requirement because it includes compliance monitoring. Specifically, the alternative would include protection monitoring (i.e., monitoring, controls, and procedures specified in project-specific health and safety plans), performance monitoring (e.g., excavation sidewall and bottom sampling, waste characterization sampling, construction quality control measures and monitoring, periodic groundwater monitoring, monitoring required by a permit or ARAR [see Appendix B]), and confirmational monitoring (e.g., periodic groundwater monitoring).
Does the Alternative Satisfy All MTCA Threshold Requirements?	**No**		**Yes**		**Yes**		**Yes**	

Notes:

ARAR: Applicable or relevant and appropriate requirement

(1) Per WAC 173-340-410(1), compliance monitoring includes protection monitoring, performance monitoring, and confirmational monitoring. Protection monitoring confirms "that human health and the environment are adequately protected during construction and the operation and maintenance period of an interim action or cleanup action as described in the safety and health plan." Performance monitoring confirms "that the interim action or cleanup action has attained cleanup standards and, if appropriate, remediation levels or other performance standards such as construction quality control measurements or monitoring necessary to demonstrate compliance with a permit or, where a permit exemption applies, the substantive requirements of other laws." Confirmational monitoring confirms "the long-term effectiveness of the interim action or cleanup action once cleanup standards and, if appropriate, remediation levels or other performance standards have been attained.

Table 6-2: Disproportionate Cost Analysis

Benefit	Weighting Factor	Alternative 1 Cap/Cover, MNA, and ICs		Alternative 2 Excavate RLs, Cap/Cover, MNA, and ICs		Alternative 3 Excavate Industrial CLs, MNA, and ICs		Alternative 4 Excavate Unrestricted CLs and MNA	
		Rating	Rationale	Rating	Rationale	Rating	Rationale	Rating	Rationale
Protectiveness [(1)]	30%	1	The rating was based on the lack of any removal of arsenic mass, the expected increased time to attain the arsenic groundwater cleanup standard relative to Alternatives 3 and 4, the substantial reliance on the integrity and maintenance of a containment system and controls for perpetuity, and the limited improvement of the overall environmental quality within the NBA.	3	The rating was based on the limited degree to which existing NBA risks would be reduced via removal of arsenic mass, the expected increased time to attain the arsenic groundwater cleanup standard relative to Alternatives 3 and 4, the substantial reliance on the integrity and maintenance of a containment system and controls for perpetuity, and the limited improvement of the overall environmental quality within the NBA.	6	The rating was based on the substantial degree to which existing NBA risks would be reduced via removal of arsenic mass, the expected reduced time to attain the arsenic groundwater cleanup standard relative to Alternatives 1 and 2, the permanent reduction of NBA risks for complete exposure pathways, and the improvement of the overall environmental quality within the NBA.	6	The rating was based on the substantial degree to which existing NBA risks would be reduced via removal of arsenic mass, the expected reduced time to attain the arsenic groundwater cleanup standard relative to Alternatives 1 and 2, the permanent reduction of NBA risks for complete exposure pathways, and the improvement of the overall environmental quality within the NBA.
Permanence	20%	1	The rating was based on the lack of any permanent reduction in toxicity, mobility, and volume for arsenic and lead contamination, the reliance upon a containment system and controls for perpetuity, and the need for continual monitoring and maintenance of the cap/cover.	2	The rating was based on the limited permanent reduction in toxicity, mobility, and volume of arsenic and lead contamination, the reliance upon a containment system and controls for perpetuity, and the need for continual monitoring and maintenance of the cap/cover.	5	The rating was based on the permanent reduction in toxicity, mobility, and volume of arsenic and lead contamination (i.e., attainment of the primary soil CLs), and very limited reliance on controls for perpetuity.	6	The rating was based on the highest permanent reduction in toxicity, mobility, and volume of arsenic and lead contamination, and the lack of reliance on a containment system or controls for perpetuity.
Effectiveness over the long term	20%	1	The rating was based on the low degree of certainty that the alternative would be successful, the fact that soil concentrations exceeding the primary soil CLs would remain for perpetuity, the perpetual reliance on a cap/cover and ICs that are not as effective or reliable as soil excavation, and the perpetual presence of residual risks for the incidental ingestion of soil pathways.	2	The rating was based on the limited degree of certainty that the alternative would be successful, the fact that soil concentrations exceeding the primary soil CLs would remain for perpetuity, the perpetual reliance on a cap/cover and ICs that are not as effective or reliable as soil excavation, and the perpetual presence of residual risks for the incidental ingestion of soil pathways.	6	The rating was based on the high degree of certainty that the alternative would be successful, the fact that soil concentrations would comply with the primary soil CL, the elimination of unacceptable residual risks for the incidental ingestion of soil pathways, and the fact that controls would not be required to contain remaining arsenic-impacted soil.	6	The rating was based on the high degree of certainty that the alternative would be successful, the fact that soil concentrations would comply with the primary soil CL, the elimination of unacceptable residual risks for the incidental ingestion of soil pathways, and the fact that controls would not be required to contain remaining arsenic-impacted soil.
Management of short-term risks	10%	5	The rating was based on the low amount of potential exposure for remediation workers, the higher amount of potential exposure for redevelopment workers, the traffic risks associated with roughly 310 off-site truck trips for borrow, and the anticipated effectiveness of measures to minimize potential worker risks (e.g., health and safety programs, construction safety practices, engineering controls).	5	The rating was based on the medium amount of potential exposure for remediation workers, the medium amount of potential exposure for redevelopment workers, the traffic risks associated with roughly 850 off-site truck trips for disposal and borrow, and the anticipated effectiveness of measures to minimize potential worker risks (e.g., health and safety programs, construction safety practices, engineering controls).	5	The rating was based on the medium amount of potential exposure for remediation workers, the low amount of potential exposure for redevelopment workers, the traffic risks associated with roughly 1,650 off-site truck trips for disposal and borrow, and the anticipated effectiveness of measures to minimize potential worker risks (e.g., health and safety programs, construction safety practices, engineering controls).	4	The rating was based on the high amount of potential exposure for remediation workers, the lower amount of potential exposure for redevelopment workers, the traffic risks associated with roughly 6,450 off-site truck trips for disposal and borrow, and the anticipated effectiveness of measures to minimize potential worker risks (e.g., health and safety programs, construction safety practices, engineering controls).
Technical and administrative implementability	10%	5	The rating was based on the fact that the alternative is technically possible, the expected availability of all necessary off-site facilities, services, and materials, the limited amount of administrative and regulatory requirements (see Appendix B) other than inhibiting and complicating future NBA redevelopment, the ability to complete remediation activities relatively quickly, the lack of current access or known utility obstruction issues within the NBA, and the lack of need to integrate remediation activities with existing facility operations or other cleanup actions.	5	The rating was based on the fact that the alternative is technically possible, the expected availability of all necessary off-site facilities, services, and materials, the limited amount of administrative and regulatory requirements (see Appendix B) other than inhibiting and complicating future NBA redevelopment, the ability to complete remediation activities relatively quickly, the lack of current access or known utility obstruction issues within the NBA, and the lack of need to integrate remediation activities with existing facility operations or other cleanup actions.	6	The rating was based on the fact that the alternative is technically possible, the expected availability of all necessary off-site facilities, services, and materials, the limited amount of administrative and regulatory requirements (see Appendix B), the ability to complete remediation activities relatively quickly, the lack of current access or known utility obstruction issues within the NBA, and the lack of need to integrate remediation activities with existing facility operations or other cleanup actions.	5	The rating was based on the fact that the alternative is technically possible, the expected availability of all necessary off-site facilities, services, and materials, the limited amount of administrative and regulatory requirements (see Appendix B), the higher complexity of remediation activities relative to the other alternatives, the lack of current access or known utility obstruction issues within the NBA, and the lack of need to integrate remediation activities with existing facility operations or other cleanup actions.
Consideration of public concerns	10%	This benefit will be formally evaluated after the public comment period for the draft FS Report and the draft CAP is completed.		This benefit will be formally evaluated after the public comment period for the draft FS Report and the draft CAP is completed.		This benefit will be formally evaluated after the public comment period for the draft FS Report and the draft CAP is completed.		This benefit will be formally evaluated after the public comment period for the draft FS Report and the draft CAP is completed.	
Total Weighted Benefit		1.7		2.7		5.1		5.1	
Estimated NPV Cost (in millions) [(2)]		$3.5		$6.2		$6.9		$18.5	
Relative Benefit/Cost Ratio [(3)]		0.49		0.44		0.74		0.28	

Notes:

Each benefit was rated from 1 (lowest rating) to 6 (highest rating) relative to the benefits provided by other alternatives.

[(1)] For this benefit, the relative reduction in arsenic mass was used as a surrogate to assess the risks associated with each alternative and the improvement of the overall environmental quality offered by each alternative.

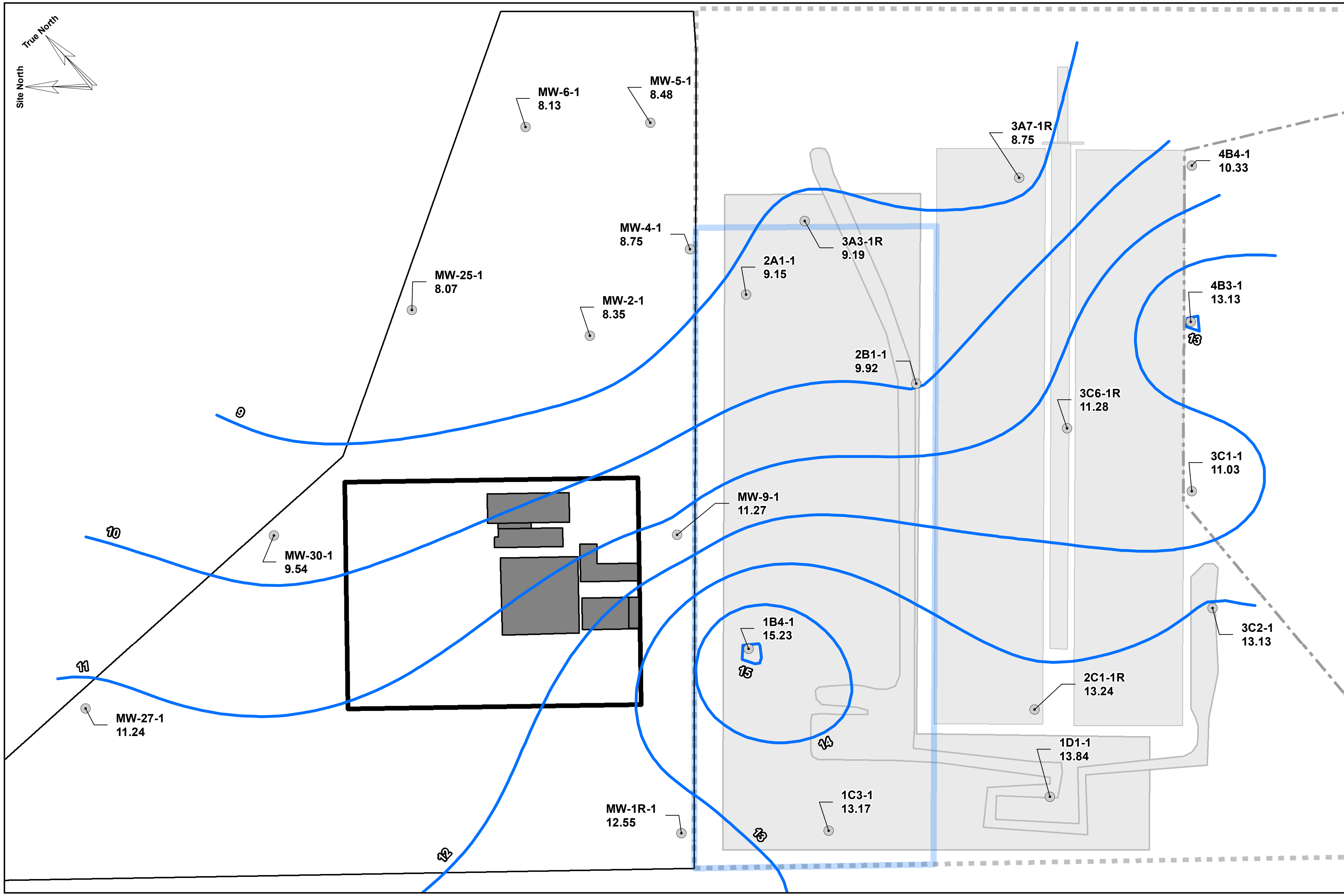
[(2)] Net present value (NPV) cost estimates are presented in Appendix C.

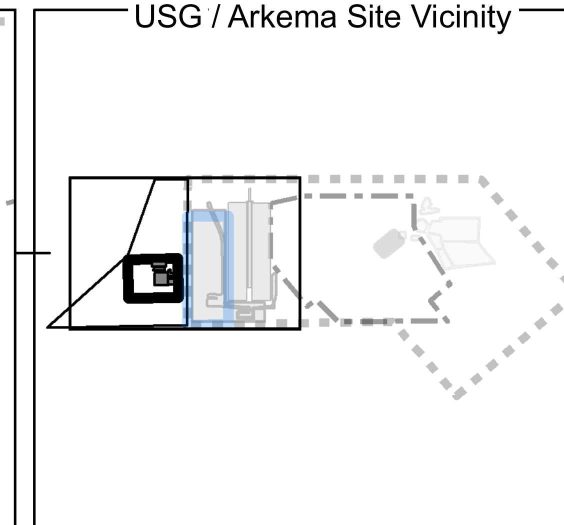
[(3)] The relative benefit/cost ratio = (protectiveness rating * 0.3 + permanence rating * 0.2 + effectiveness over the long term rating * 0.2 + management of short-term risks rating * 0.1 + technical and administrative implementability rating * 0.1 + consideration of public concerns * 0.1)/estimated NPV cost in millions of dollars.

Table 6-3: Reasonable Restoration Time Frame Evaluation

<table>
<tr><th colspan="2">Criterion</th><th>Is the Criterion Relevant for Differentiating Between Alternatives?</th><th>Alternative 1
Cap/Cover, MNA, and ICs</th><th>Alternative 2
Excavate RLs, Cap/Cover, MNA, and ICs</th><th>Alternative 3
Excavate Industrial CLs, MNA, and ICs</th><th>Alternative 4
Excavate Unrestricted CLs and MNA</th></tr>
<tr><td colspan="2">Estimated soil restoration time frame</td><td>No</td><td colspan="4">The estimated restoration time frame to achieve soil cleanup standards is the same for Alternatives 1 through 4. For all four alternatives, soil cleanup standards would be achieved as soon as remediation construction activities are completed (e.g., within one to two years following completion of the final CAP). Thus, all four alternatives provide for a reasonable soil restoration time frame.</td></tr>
<tr><td colspan="2">Estimated groundwater restoration time frame</td><td>Yes</td><td colspan="4">The groundwater restoration time frames are expected to depend almost entirely on the degree of soil contamination removal associated with each alternative. Although the current maximum dissolved arsenic concentration in a likely shoreline POC MW (3A3-1R) is only one order of magnitude greater than the 8 ug/L arsenic groundwater CL (see Section 3.4.2), the estimated groundwater restoration time frame for the MNA in Alternative 1 to achieve the arsenic groundwater CL in 3A3-1R (based on calculations with Ecology's Temporal Analysis Tool at https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Contamination-clean-up-tools) is expected to be greater than 100 years (see Appendix D). Conversely, the estimated groundwater restoration time frames for Alternatives 3 and 4 are expected to be relatively short given the substantial amount of arsenic mass removal included in both alternatives. A helpful case study for the effect of removing substantial amounts of similar soil contamination on arsenic groundwater concentrations is the 1999 MW9 area IA (AGI Technologies 2000; CDM Smith 2016). The removal of arsenic soil concentrations exceeding 200 mg/kg during that 1999 MW9 area IA resulted in the average MW9 pre-excavation arsenic groundwater concentration of approximately 8,000 ug/L decreasing by one order of magnitude within two years and two orders of magnitude within seven years (see Figure 2-6 for the locations of MW9 and the MW9 area IA). In addition, based on calculations with Ecology's Temporal Analysis Tool, the arsenic groundwater concentrations in MW9 are expected to decrease by another order of magnitude (and achieve the arsenic groundwater CL) by approximately 2022 to 2025 (see Appendix D). Based on the empirical results of the MW9 area IA case study (i.e., an order of magnitude decrease in two years and a second order of magnitude decrease in five years), the estimated time frame for Alternatives 3 and 4 to achieve the needed one order of magnitude reduction in order to attain the arsenic groundwater CL in 3A3-1R is conservatively estimated to be 10 years. Finally, there is significant uncertainty as to whether the groundwater restoration time frame for Alternative 2 would be acceptable for the NBA (e.g., within approximately 30 years) since Alternative 2 only includes limited soil excavation and arsenic soil concentrations up to 1,060 mg/kg would remain in the NBA for perpetuity.</td></tr>
<tr><td rowspan="9">Factors to be considered when determining whether an alternative provides for a reasonable restoration time frame</td><td>Potential risks posed by the site to human health and environment</td><td>Yes</td><td colspan="4">All four alternatives can protect human health and environment (see Table 6-1). However, Alternatives 3 and 4 would pose less potential risk to human health and the environment than Alternatives 1 and 2 because less arsenic would remain in soil, soil CLs for current and anticipated future land use would be achieved, and the groundwater restoration time frames would be shorter.</td></tr>
<tr><td>Practicability of achieving a shorter restoration time frame</td><td>Yes</td><td colspan="4">Although Alternatives 1 through 4 would have the same soil restoration time frame, each alternative would have a different groundwater restoration time frame depending on the degree of soil excavation. Since (1) soil excavation is a practicable remedial component, and (2) Alternatives 3 and 4 would provide shorter groundwater restoration time frames than Alternatives 1 and 2, it is practicable to achieve a shorter groundwater restoration time frame than what Alternatives 1 and 2 would provide.</td></tr>
<tr><td>Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site</td><td>No</td><td colspan="4">This factor is not relevant for evaluating Alternatives 1 through 4 since (1) the NBA is currently undeveloped, and (2) any current effects of NBA COCs on surrounding areas and associated resources (i.e., Hylebos Waterway) are negligible because (a) dissolved arsenic concentrations in the Second Aquifer and Deep Aquifer MWs located closest to the Hylebos Waterway (i.e., 3.4 ug/L in 3A2-2R and less than 1.6 ug/L in 3A1-3R) are less than the arsenic groundwater CL of 8 ug/L (which is protective of human health and the environment), and (b) it is highly unlikely that there is a Surface Aquifer arsenic discharge to the Hylebos Waterway that exceeds the arsenic groundwater CL of 8 ug/L. A Surface Aquifer arsenic discharge exceeding 8 ug/L is highly unlikely because (1) the 2017 dissolved arsenic concentration in 3A3-1R (the Surface Aquifer MW located closest to the Hylebos Waterway) was only 58 ug/L, (2) the dissolved arsenic concentrations in 3A3-1R are stable or declining (see Appendix D), and (3) substantial amounts of arsenic natural attenuation occurs on the Arkema Property between vertical shoreline MWs similar to 3A3-1R and Hylebos Waterway surface water (PIONEER 2019).</td></tr>
<tr><td>Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site</td><td>Yes</td><td colspan="4">Although the surrounding areas and associated resources will not be affected in the future by NBA COCs for the reasons discussed in the above row, the ability to successfully redevelop the NBA will depend in part on the amount of contamination remaining after remediation. For instance, it would be much easier to redevelop the NBA if Alternative 3 or Alternative 4 is the selected remedy since all arsenic and lead soil concentrations would comply with the Industrial Soil CLs.</td></tr>
<tr><td>Availability of alternative water supplies</td><td>No</td><td colspan="4">This factor is not relevant to evaluating Alternatives 1 through 4 since (1) impacted NBA groundwater is not potable because of salinity from salt water intrusion and historical storage of salt on the salt pads, and (2) the City of Tacoma municipal water supply is readily available for any future land use.</td></tr>
<tr><td>Likely effectiveness and reliability of institutional controls</td><td>Yes</td><td colspan="4">Although (1) ICs are generally effective and reliable, and (2) it is unlikely that certain restricted activities (e.g., residential land use, drinking water use) would occur given anticipated future land use and the salinity of impacted groundwater, excavation of soil contamination would be much more effective and reliable than ICs. Alternative 1 relies heavily on ICs and does not include any excavation of soil contamination. Progressively larger amounts of soil contamination would be removed with Alternative 2, Alternative 3, and Alternative 4, respectively. Note that protection of the Hylebos Waterway is not germane to the evaluation of this criterion since it is highly unlikely that the Hylebos Waterway is currently adversely affected, or will be adversely affected in the future, as a result of NBA groundwater concentrations as discussed above.</td></tr>
<tr><td>Ability to control and monitor migration of hazardous substances from the site</td><td>Yes</td><td colspan="4">Excavation of similar soil contamination has been shown to substantially reduce arsenic concentrations and control arsenic migration in groundwater (CDM Smith 2016). Alternative 1 does not include any soil excavation. Progressively larger amounts of soil contamination would be removed with Alternative 2, Alternative 3, and Alternative 4, respectively. All four alternatives would provide for monitoring of potential arsenic migration.</td></tr>
<tr><td>Toxicity of the hazardous substances at the site</td><td>Yes</td><td colspan="4">Arsenic and lead are both toxic, depending on the dose. No arsenic or lead would be removed with Alternative 1. Progressively larger amounts of arsenic and lead would be removed with Alternative 2, Alternative 3, and Alternative 4, respectively.</td></tr>
<tr><td>Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions</td><td>Yes</td><td colspan="4">Although arsenic and lead cannot be destroyed or degraded by natural processes, arsenic groundwater migration can be attenuated by natural processes such as adsorption of arsenic onto solid media and precipitation/co-precipitation of arsenic with solid minerals. However, some of these natural processes can be reversible if geochemical conditions change over time. Alternative 1 would be entirely reliant on potentially reversible natural processes. Reliance on natural processes would progressively decrease with Alternative 2, Alternative 3, and Alternative 4, respectively.</td></tr>
<tr><td colspan="3">Does the Alternative Provide for a Reasonable Restoration Time Frame?</td><td>No</td><td>Uncertain</td><td>Yes</td><td>Yes</td></tr>
<tr><td colspan="3">Rationale</td><td>The estimated groundwater restoration time frame of greater than 100 years is unacceptable for the NBA, and it is practicable to achieve a shorter groundwater restoration time frame with soil excavation. Furthermore, Alternative 1 is not a favorable alternative in terms of the "factors to be considered when determining whether an alternative provides for a reasonable restoration time frame."</td><td>It is uncertain if Alternative 2 would be able to achieve the arsenic groundwater cleanup standard within an acceptable restoration time frame for the NBA (e.g., within approximately 30 years), and it is practicable to achieve a shorter groundwater restoration time frame with more soil excavation than what Alternative 2 provides. Furthermore, Alternative 2 is less favorable than Alternatives 3 and 4 in terms of the "factors to be considered when determining whether an alternative provides for a reasonable restoration time frame" since Alternative 2 includes less soil excavation than Alternatives 3 and 4.</td><td>Alternative 3 would be expected to achieve the arsenic groundwater cleanup standard within approximately 10 years. Furthermore, Alternative 3 is a favorable alternative in terms of the "factors to be considered when determining whether an alternative provides for a reasonable restoration time frame."</td><td>Alternative 4 would be expected to achieve the arsenic groundwater cleanup standard within approximately 10 years. Furthermore, Alternative 4 is the most favorable alternative in terms of the "factors to be considered when determining whether an alternative provides for a reasonable restoration time frame."</td></tr>
</table>

Appendix A





Legend

- Groundwater Contour (Contour Interval = 1 foot)
- **9.50** Groundwater Elevation
- Upper Aquifer

Former USG Manufacturing
- Former Manufacturing Area Boundary
- Other Key Features

Former Arkema Manufacturing
- Former Central Manufacturing Area
- Other Key Features

Boundaries
- North Boundary Area
- USG Property Boundary
- Arkema Property Boundary

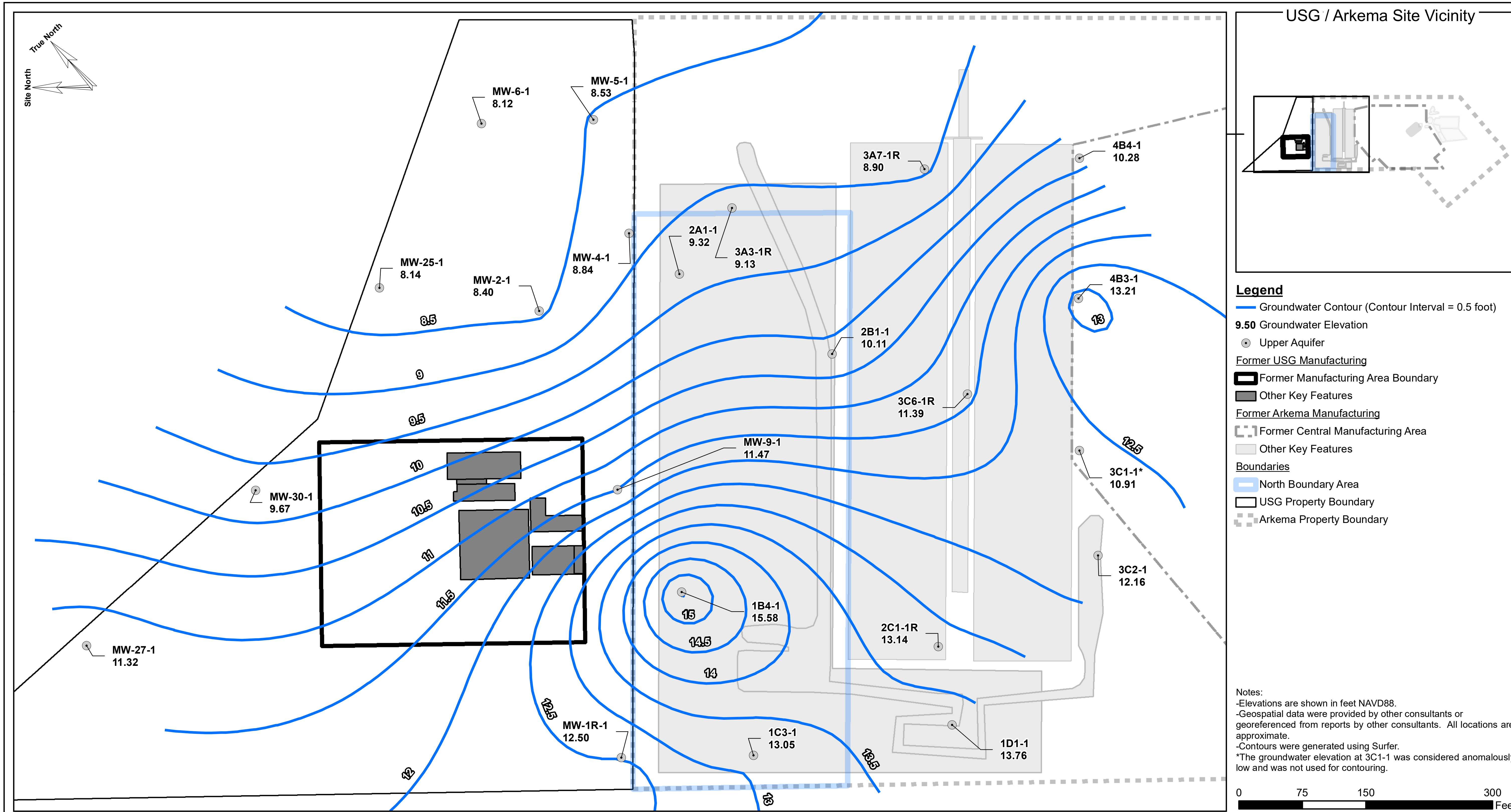
Notes:
-Elevations are shown in feet NAVD88.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
-Countours were generated using Surfer.

0 75 150 300 Feet

PIONEER
TECHNOLOGIES CORPORATION

March 13, 2012 Low Tide
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

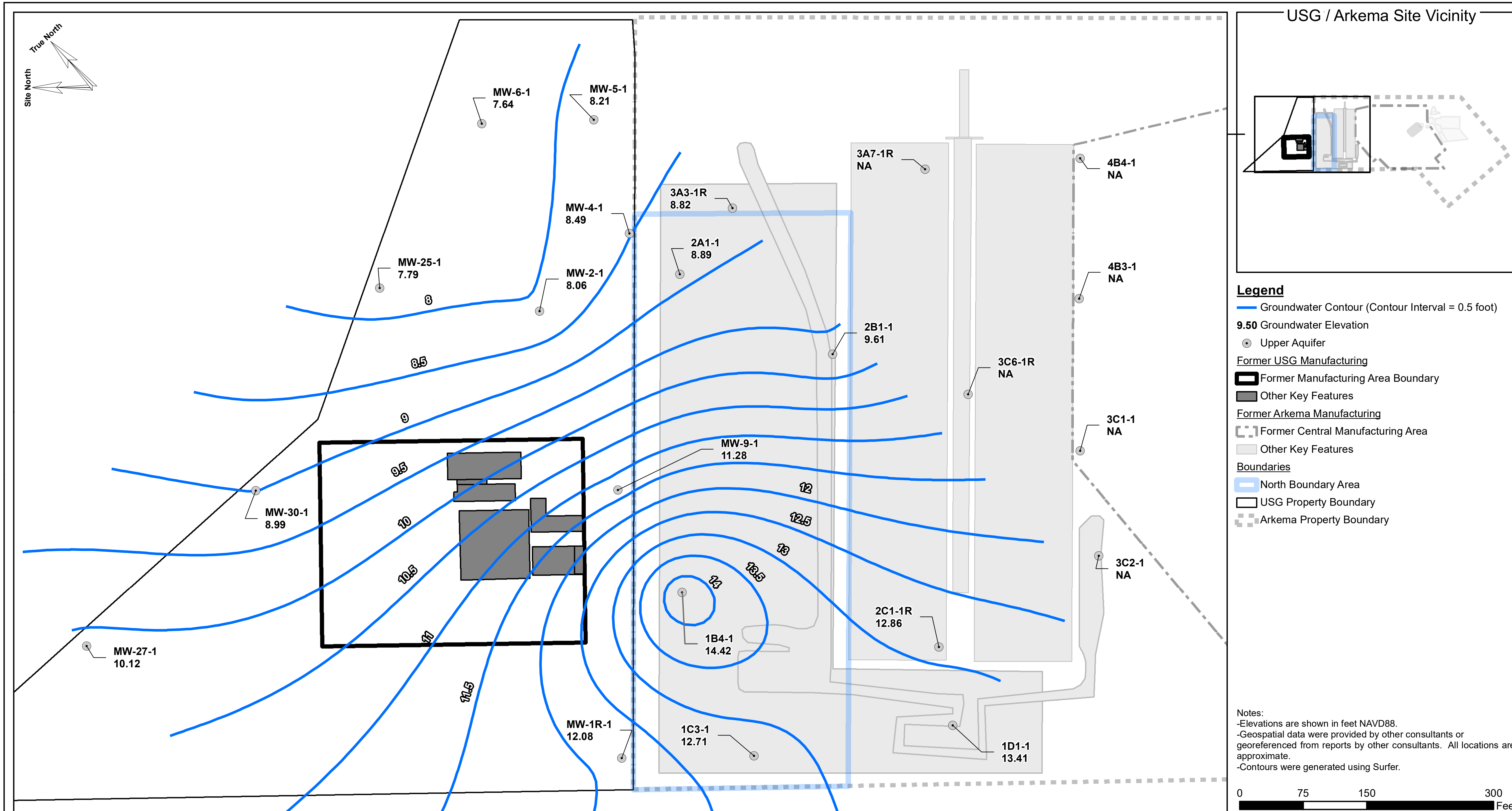
Figure 1



PIONEER TECHNOLOGIES CORPORATION

March 14, 2012 High Tide
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

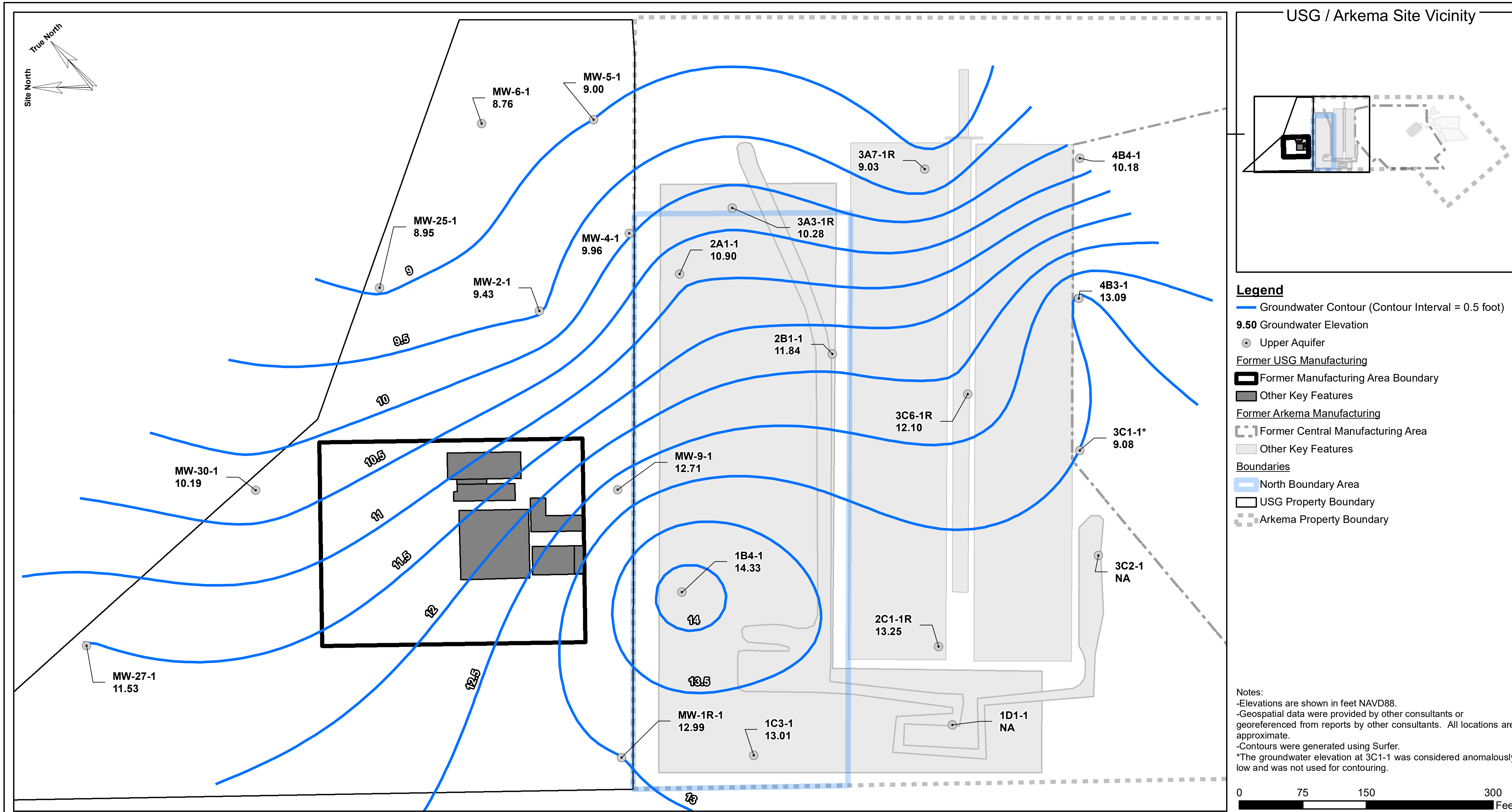
Figure 2



PIONEER
TECHNOLOGIES CORPORATION

January 16, 2014
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

Figure 3

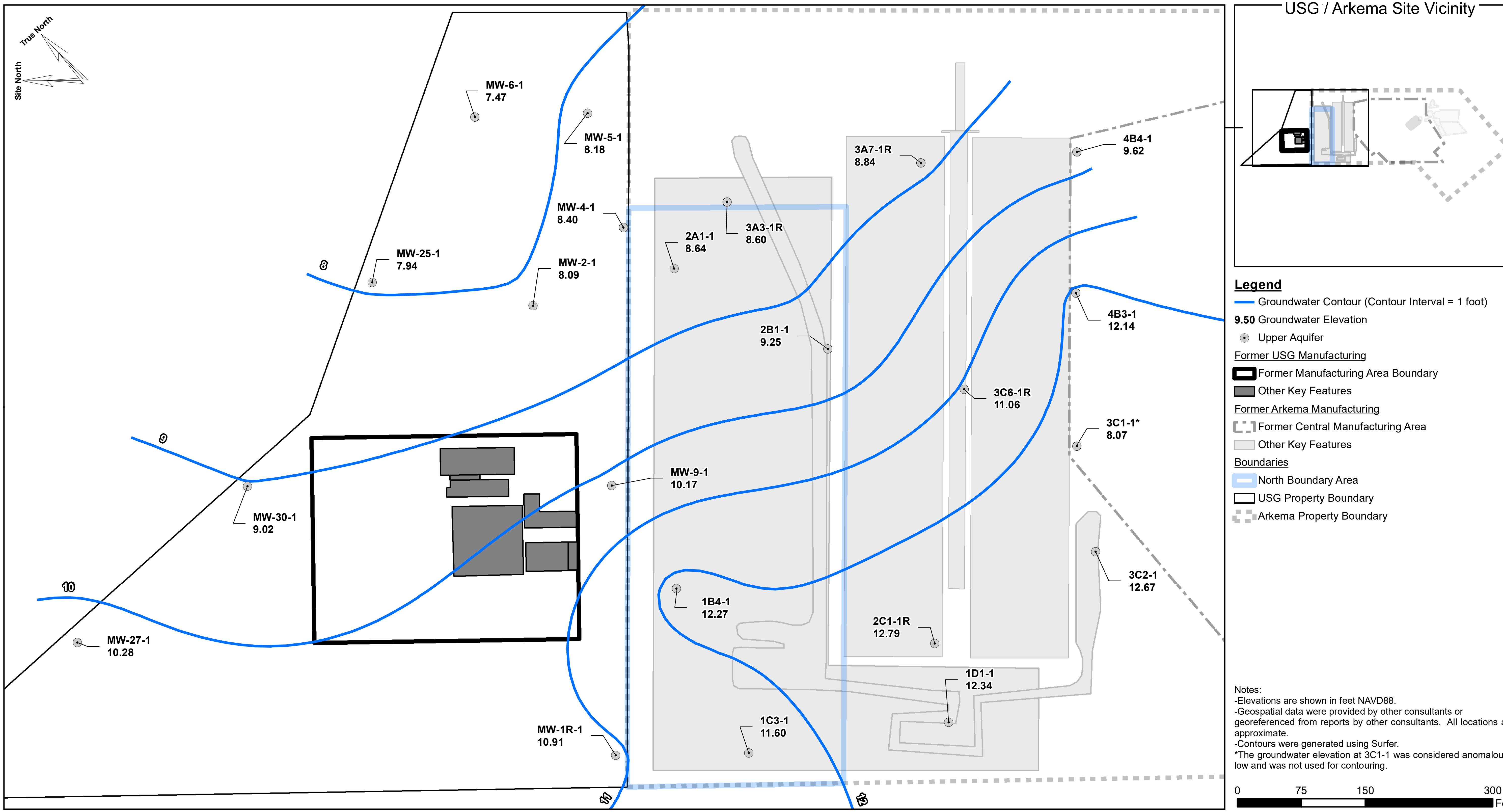


PIONEER
TECHNOLOGIES CORPORATION

March 17, 2017
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

Figure 4

Document Path: G:\Projects\Arkema\Maps\2022\MW Survey and Recalc Elev\Fig 4_UA GW Flow March 2017.mxd; Author: VN; Date Saved: 8/11/2022



Legend

Groundwater Contour (Contour Interval = 1 foot)

9.50 Groundwater Elevation

Upper Aquifer

Former USG Manufacturing

Former Manufacturing Area Boundary

Other Key Features

Former Arkema Manufacturing

Former Central Manufacturing Area

Other Key Features

Boundaries

North Boundary Area

USG Property Boundary

Arkema Property Boundary

Notes:
-Elevations are shown in feet NAVD88.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
-Contours were generated using Surfer.
*The groundwater elevation at 3C1-1 was considered anomalously low and was not used for contouring.

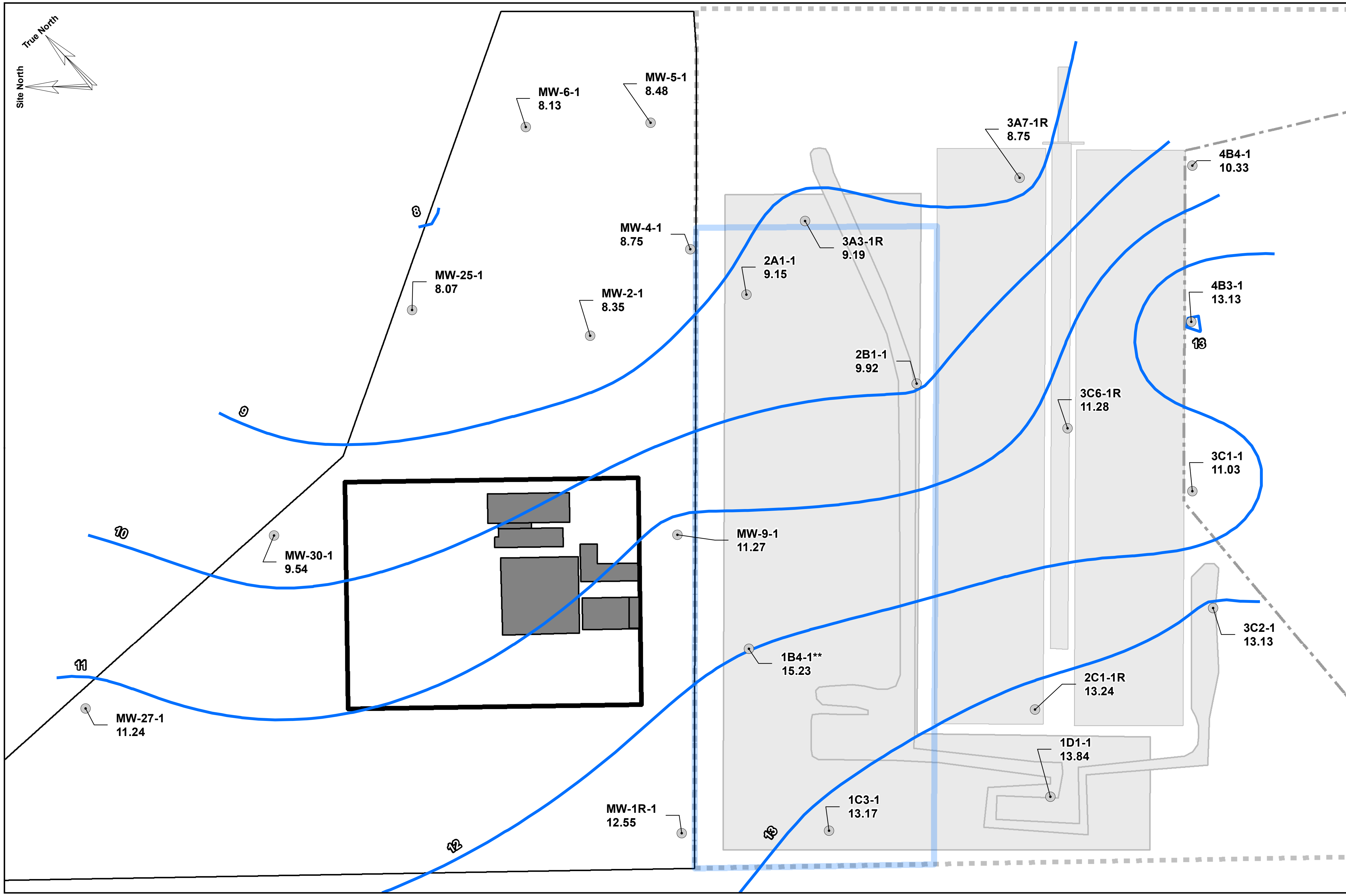
0 75 150 300 Feet

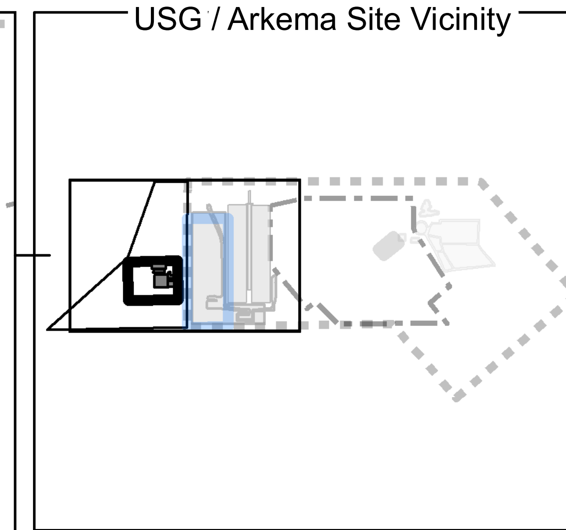
Document Path: G:\Projects\Arkema\Maps\2022\MW Survey and Recalc Elev\Fig 5_UA GW Flow June 2022 LT.mxd; Author: VN; Date Saved: 8/11/2022

PIONEER TECHNOLOGIES CORPORATION

June 23, 2022 Low Tide
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

Figure 5





Legend

Groundwater Contour (Contour Interval = 1 foot)

9.50 Groundwater Elevation

Upper Aquifer

Former USG Manufacturing

Former Manufacturing Area Boundary

Other Key Features

Former Arkema Manufacturing

Former Central Manufacturing Area

Other Key Features

Boundaries

North Boundary Area

USG Property Boundary

Arkema Property Boundary

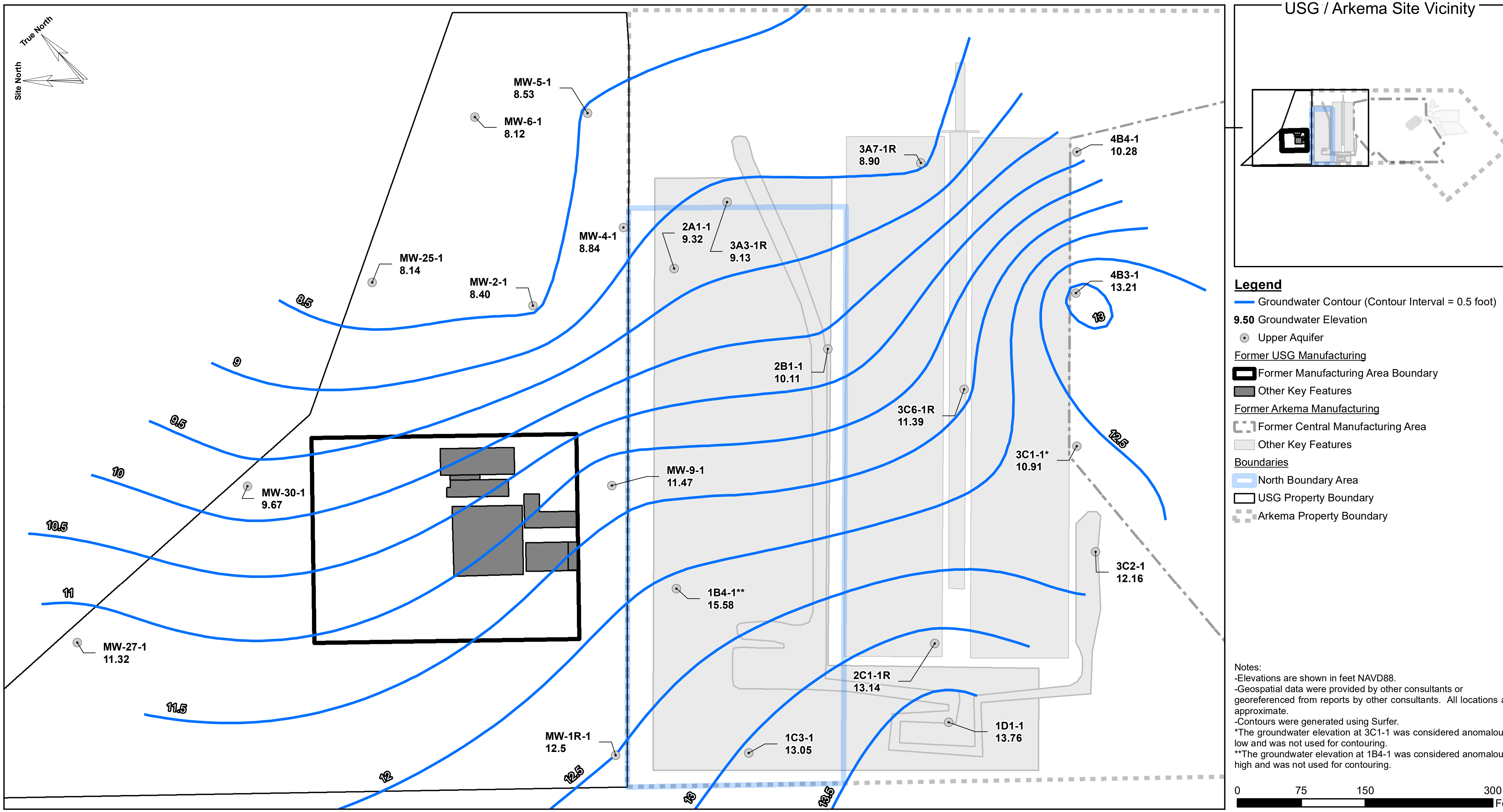
Notes:
-Elevations are shown in feet NAVD88.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
-Contours were generated using Surfer.
**The groundwater elevation at 1B4-1 was considered anomalously high and was not used for contouring.

0 75 150 300 Feet

PIONEER
TECHNOLOGIES CORPORATION

March 13, 2012 Low Tide Omitting 1B4-1
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

Figure 6

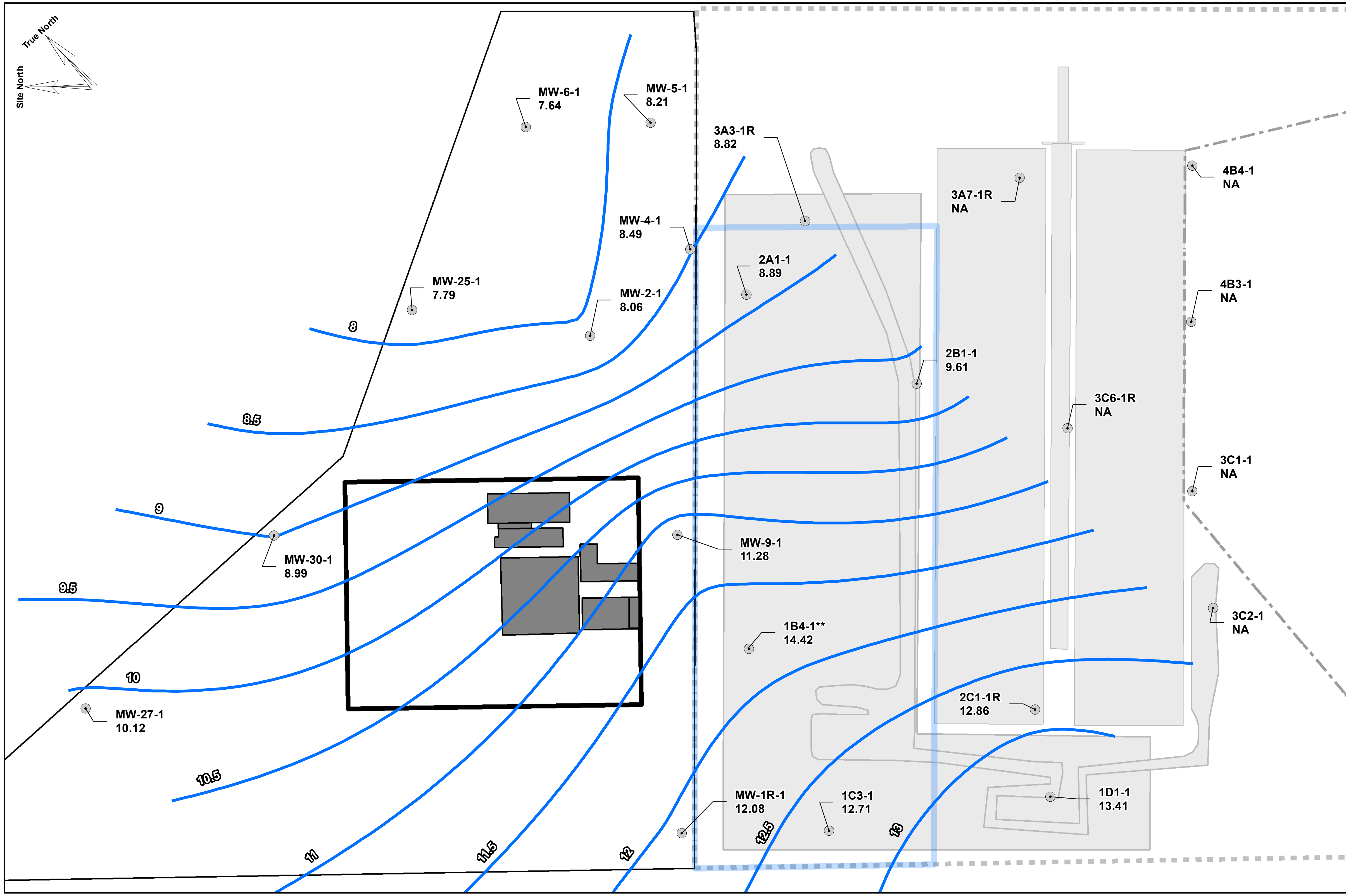


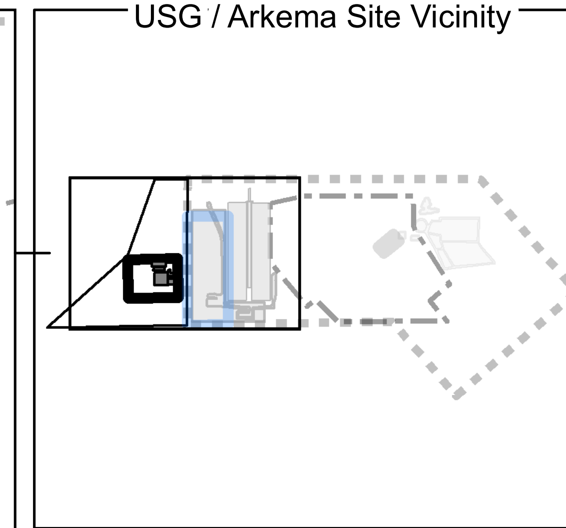
Notes:
-Elevations are shown in feet NAVD88.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
-Contours were generated using Surfer.
*The groundwater elevation at 3C1-1 was considered anomalously low and was not used for contouring.
**The groundwater elevation at 1B4-1 was considered anomalously high and was not used for contouring.

PIONEER TECHNOLOGIES CORPORATION

March 14, 2012 High Tide Omitting 1B4-1
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

Figure 7





Legend

- Groundwater Contour (Contour Interval = 0.5 foot)
- **9.50** Groundwater Elevation
- Upper Aquifer

Former USG Manufacturing
- Former Manufacturing Area Boundary
- Other Key Features

Former Arkema Manufacturing
- Former Central Manufacturing Area
- Other Key Features

Boundaries
- North Boundary Area
- USG Property Boundary
- Arkema Property Boundary

Notes:
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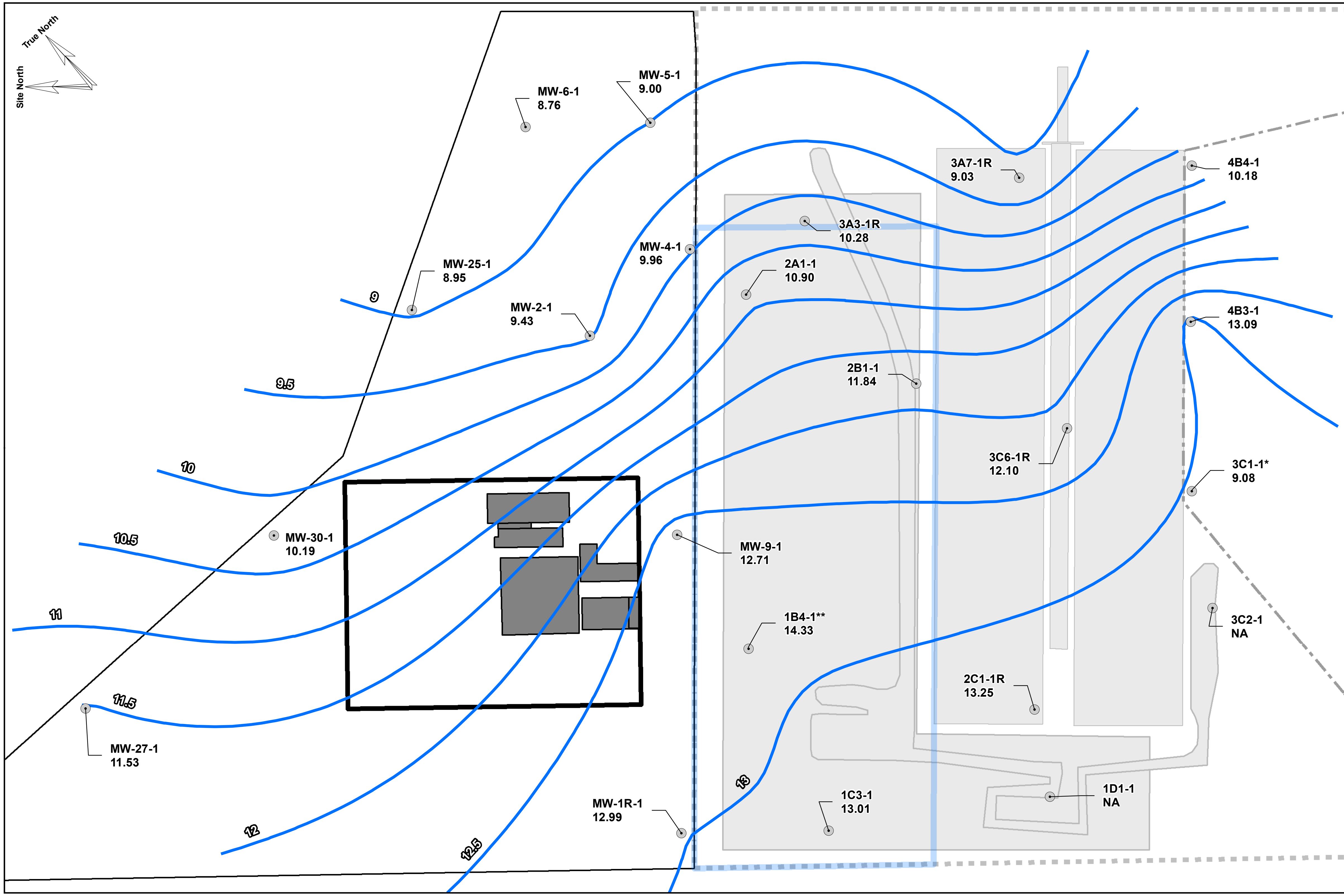
-Contours were generated using Surfer.
**The groundwater elevation at 1B4-1 was considered anomalously high and was not used for contouring.

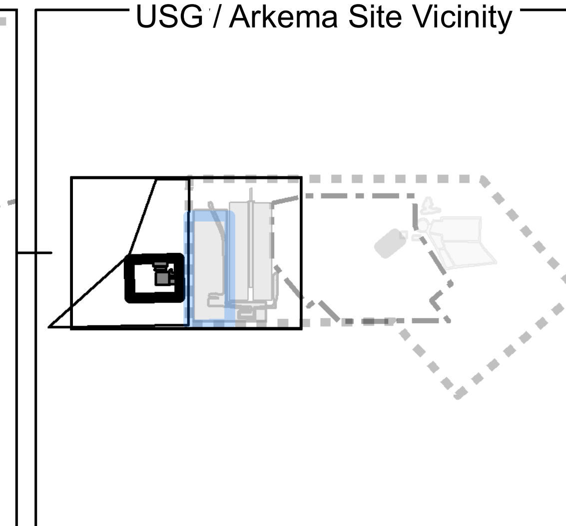
0 75 150 300 Feet

PIONEER TECHNOLOGIES CORPORATION

January 16, 2014 Omitting 1B4-1
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

Figure 8





Legend

Groundwater Contour (Contour Interval = 0.5 foot)

9.50 Groundwater Elevation

Upper Aquifer

Former USG Manufacturing

Former Manufacturing Area Boundary

Other Key Features

Former Arkema Manufacturing

Former Central Manufacturing Area

Other Key Features

Boundaries

North Boundary Area

USG Property Boundary

Arkema Property Boundary

Notes:
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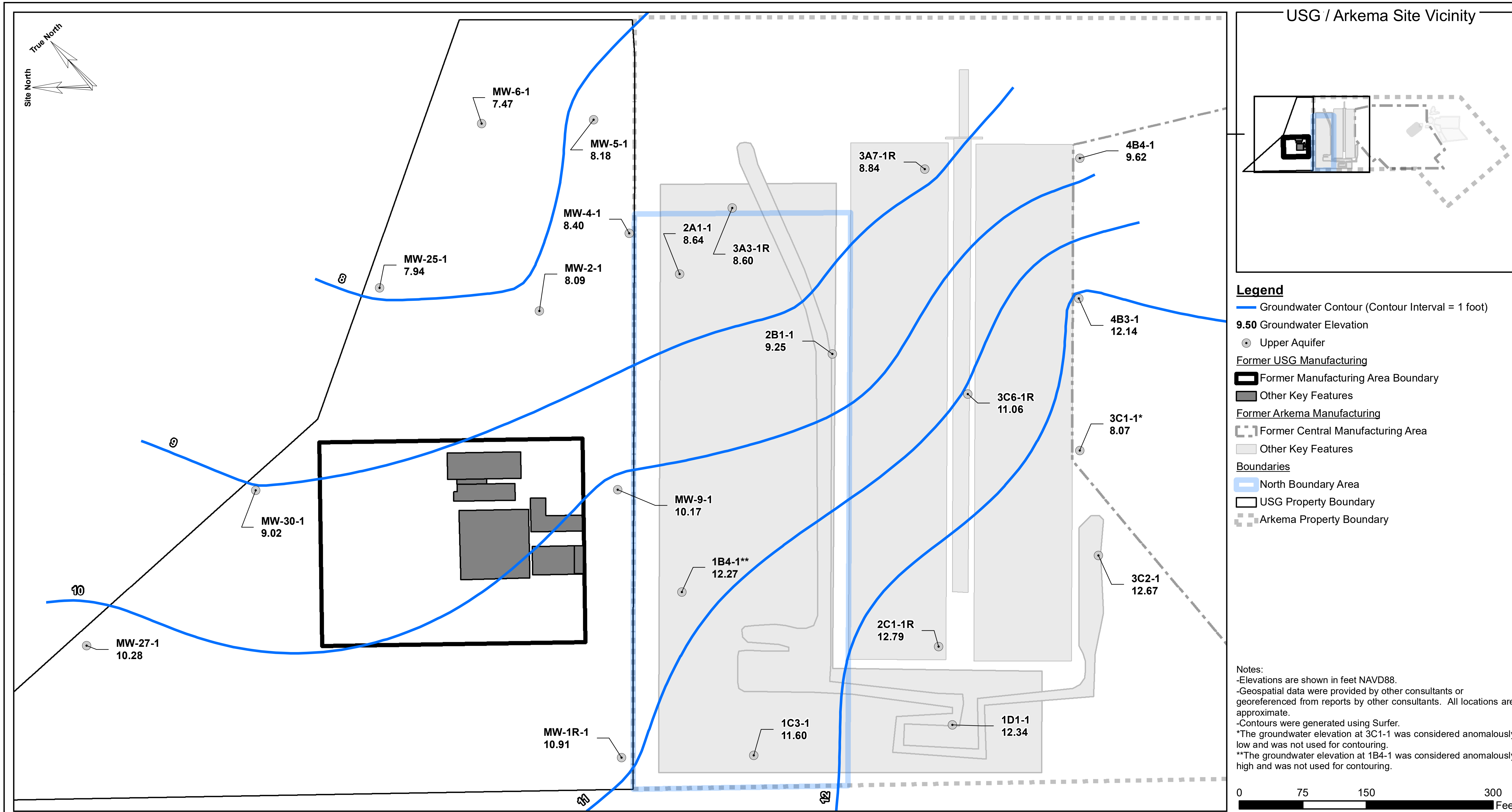
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
-Contours were generated using Surfer.
*The groundwater elevation at 3C1-1 was considered anomalously low and was not used for contouring.
**The groundwater elevation at 1B4-1 was considered anomalously high and was not used for contouring.

0 75 150 300 Feet

PIONEER
TECHNOLOGIES CORPORATION

March 17, 2017 Omitting 1B4-1
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

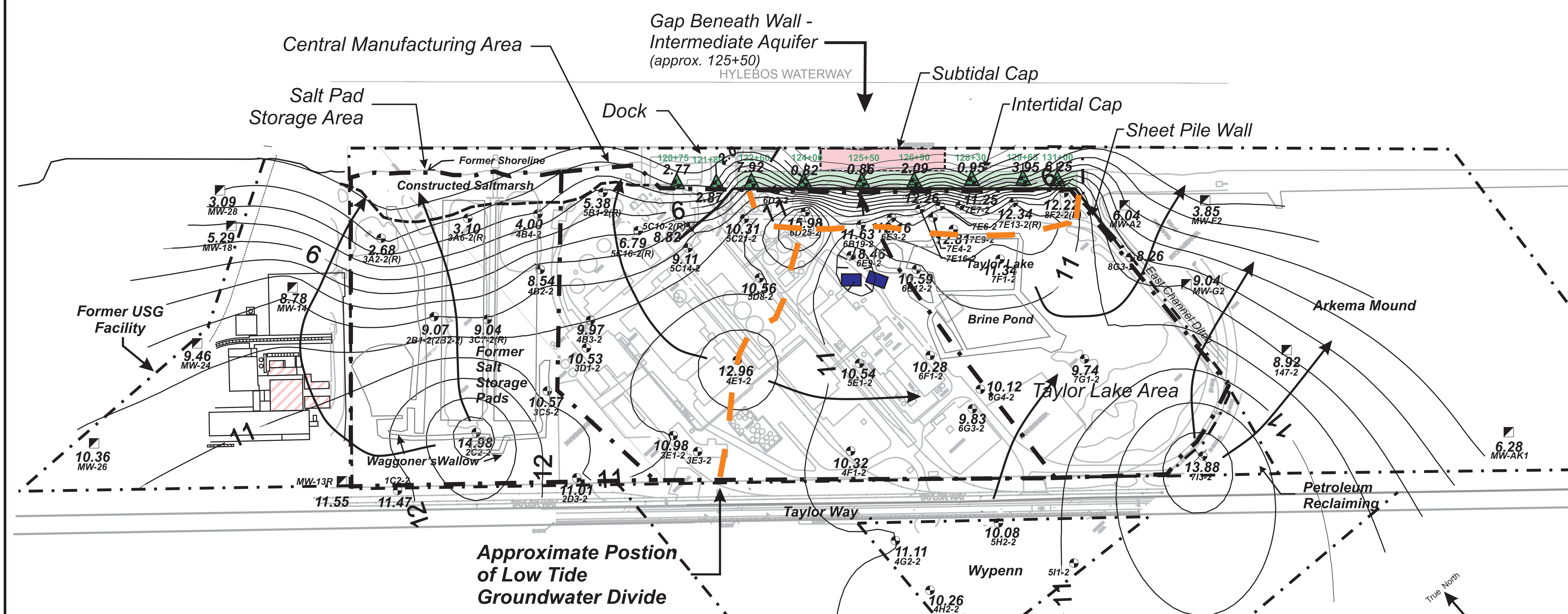
Figure 9



PIONEER
TECHNOLOGIES CORPORATION

June 23, 2022 Low Tide Omitting 1B4-1
2012 - 2022 NBA and USG Property Upper Aquifer Groundwater Elevations

Figure 10



Existing OMMP Monitoring Well Sept. 2012

Existing Off-Site Monitoring Well Sept. 2012

Penite Pits

Elevation Contour

Est. Horizontal Groundwater Flow Gradient Direction

Existing Monitoring Well - Sept. 2012

5.38
Water Level Elev. (ft-MLLW) on March 13, 2012 - Low Tide -0.6 feet MLLW

Note: Base map shows plant facilities prior to demolition

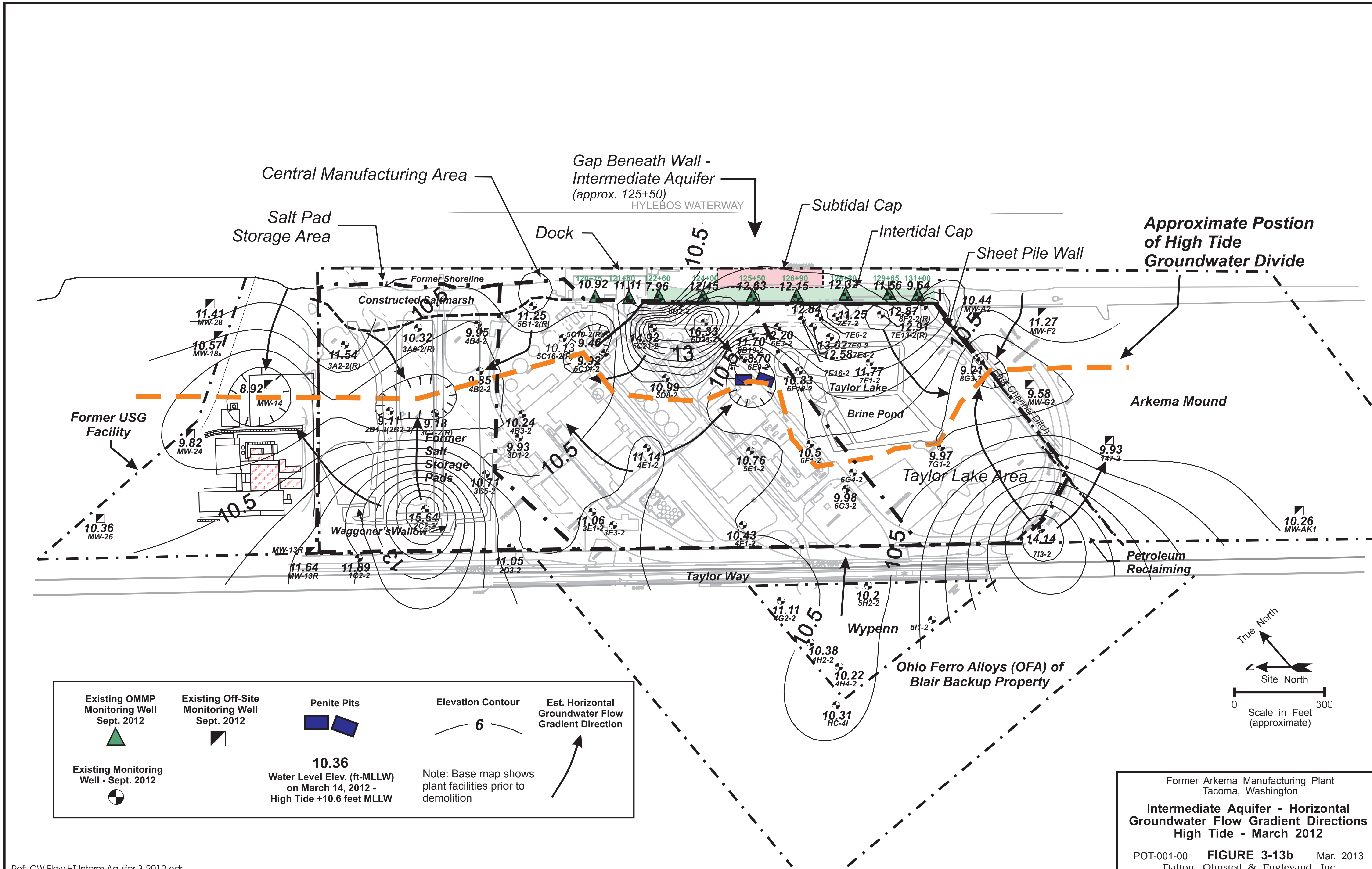
Former Arkema Manufacturing Plant
Tacoma, Washington

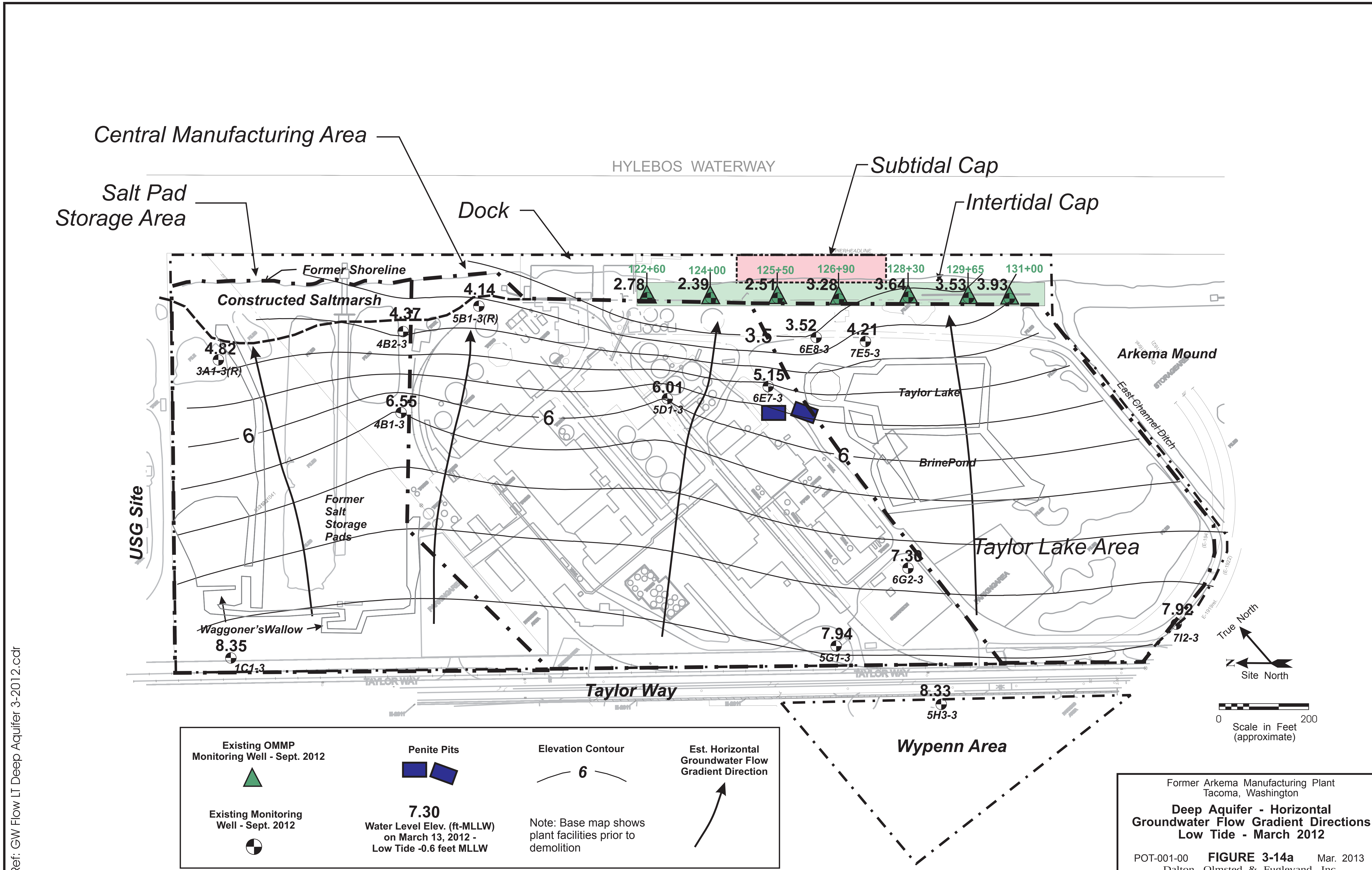
Intermediate Aquifer - Horizontal Groundwater Flow Gradient Directions Low Tide - March 2012

POT-001-00 **FIGURE 3-13a** Mar. 2013

Dalton, Olmsted & Fuglevand, Inc.

Ref: GW Flow Directin LT Interim Aquifer 3-2-12.cdr


Central Manufacturing Area
Gap Beneath Wall -
Intermediate Aquifer
(approx. 125+50)
HYLEBOS WATERWAY
Salt Pad
Storage Area
Dock
Subtidal Cap
Intertidal Cap
Sheet Pile Wall
Approximate Postion
of High Tide
Groundwater Divide
Former Shoreline
Constructed Saltmarsh
Former USG
Facility
Former
Salt
Storage
Pads
Waggoner'sWallow
Taylor Lake
Brine Pond
Taylor Lake Area
Arkema Mound
Petroleum
Reclaiming
Taylor Way
Wypenn
Ohio Ferro Alloys (OFA) of
Blair Backup Property
True North
Site North
0
300
Scale in Feet
(approximate)
Existing OMMP
Monitoring Well
Sept. 2012
Existing Off-Site
Monitoring Well
Sept. 2012
Penite Pits
Elevation Contour
6
Est. Horizontal
Groundwater Flow
Gradient Direction
Existing Monitoring
Well - Sept. 2012
10.36
Water Level Elev. (ft-MLLW)
on March 14, 2012 -
High Tide +10.6 feet MLLW
Note: Base map shows
plant facilities prior to
demolition
Former Arkema Manufacturing Plant
Tacoma, Washington
Intermediate Aquifer - Horizontal
Groundwater Flow Gradient Directions
High Tide - March 2012
POT-001-00
FIGURE 3-13b
Mar. 2013
Dalton, Olmsted & Fuglevand, Inc.
Ref: GW Flow HT Interm Aquifer 3-2012.cdr

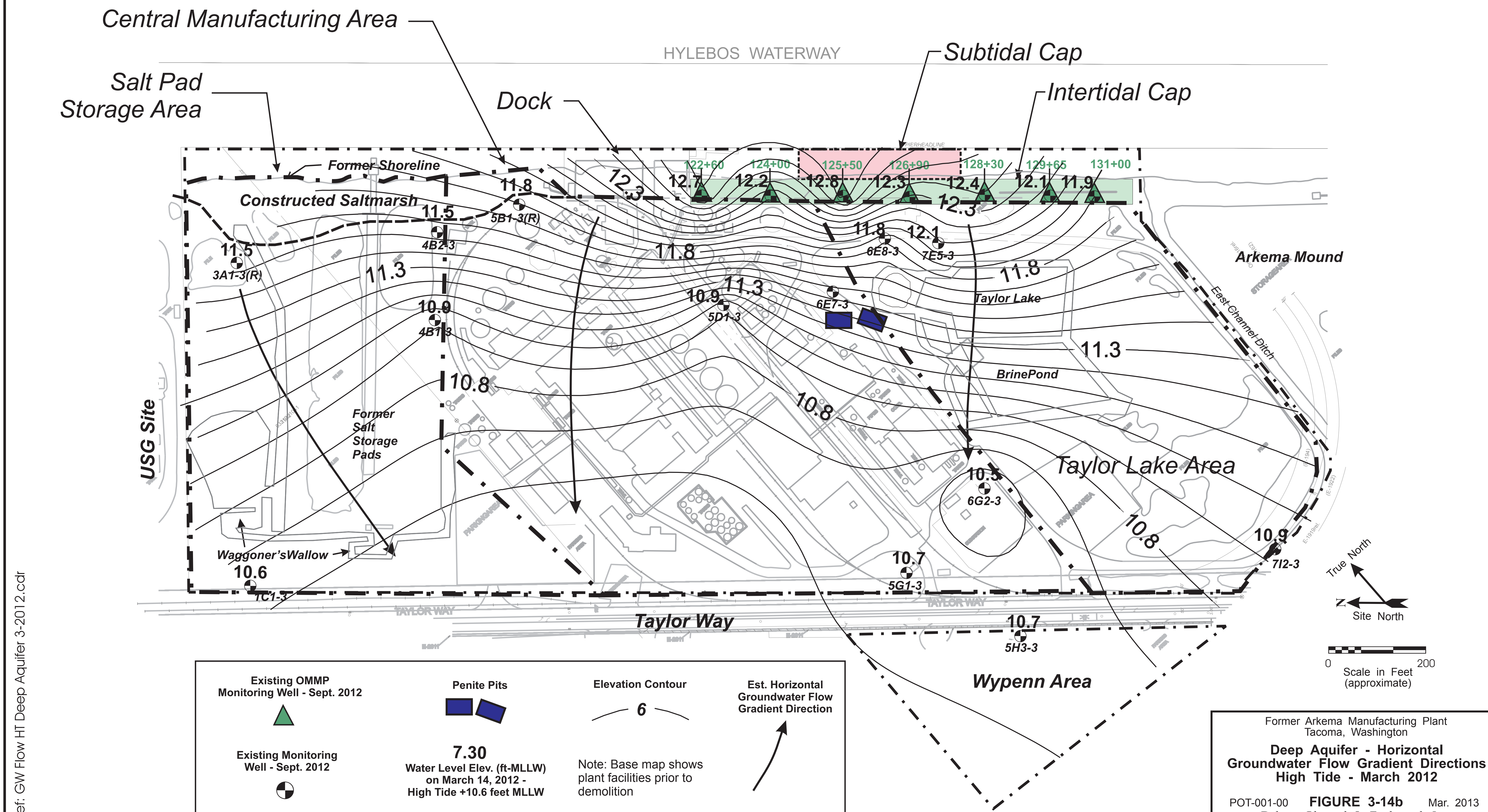


Former Arkema Manufacturing Plant
Tacoma, Washington

Deep Aquifer - Horizontal Groundwater Flow Gradient Directions Low Tide - March 2012

POT-001-00 **FIGURE 3-14a** Mar. 2013

Dalton, Olmsted & Fuglevand, Inc.



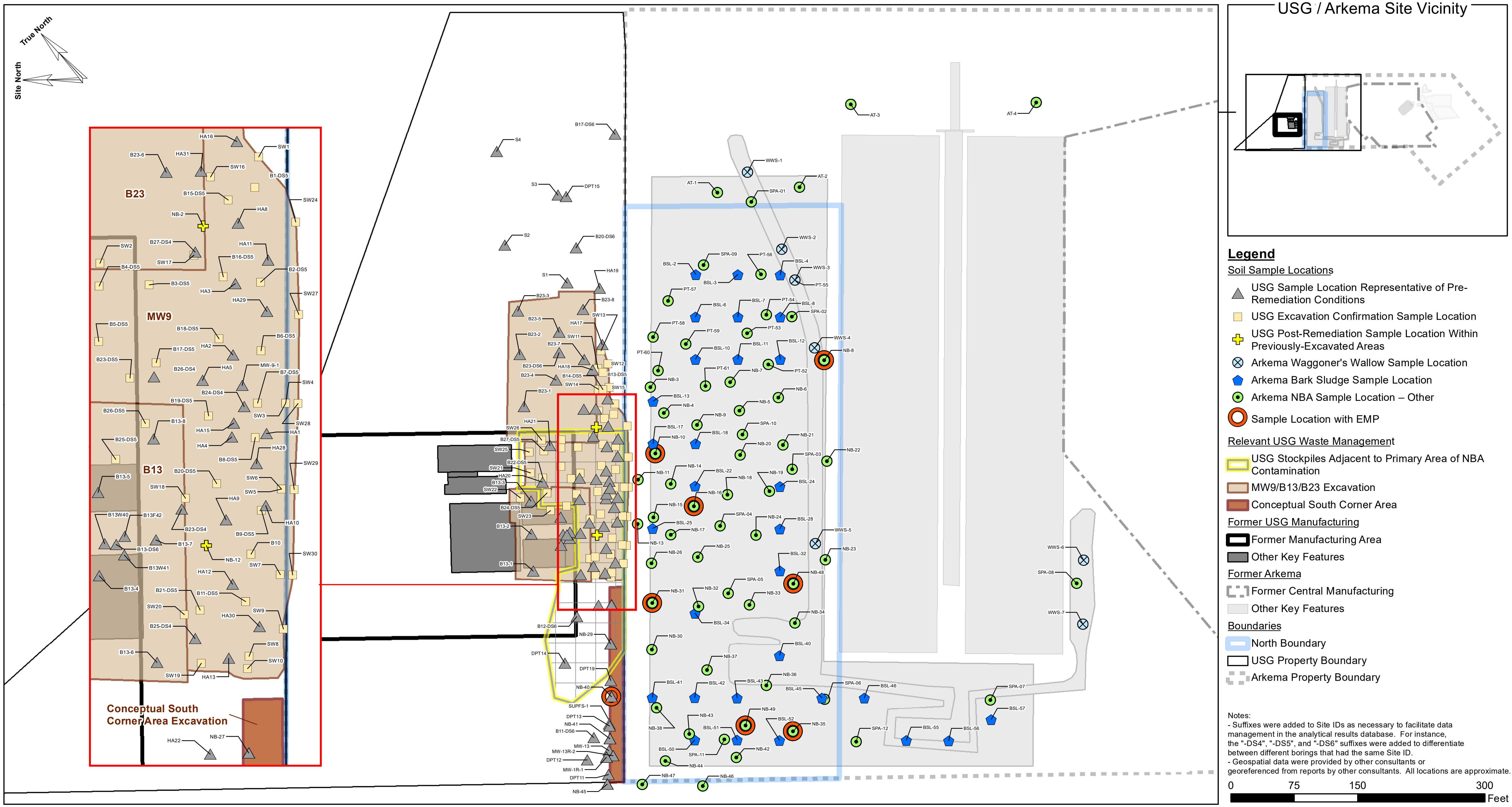
Former Arkema Manufacturing Plant
Tacoma, Washington

Deep Aquifer - Horizontal Groundwater Flow Gradient Directions High Tide - March 2012

POT-001-00 **FIGURE 3-14b** Mar. 2013

Dalton, Olmsted & Fuglevand, Inc.

Ref: GW Flow HT Deep Aquifer 3-2012.cdr



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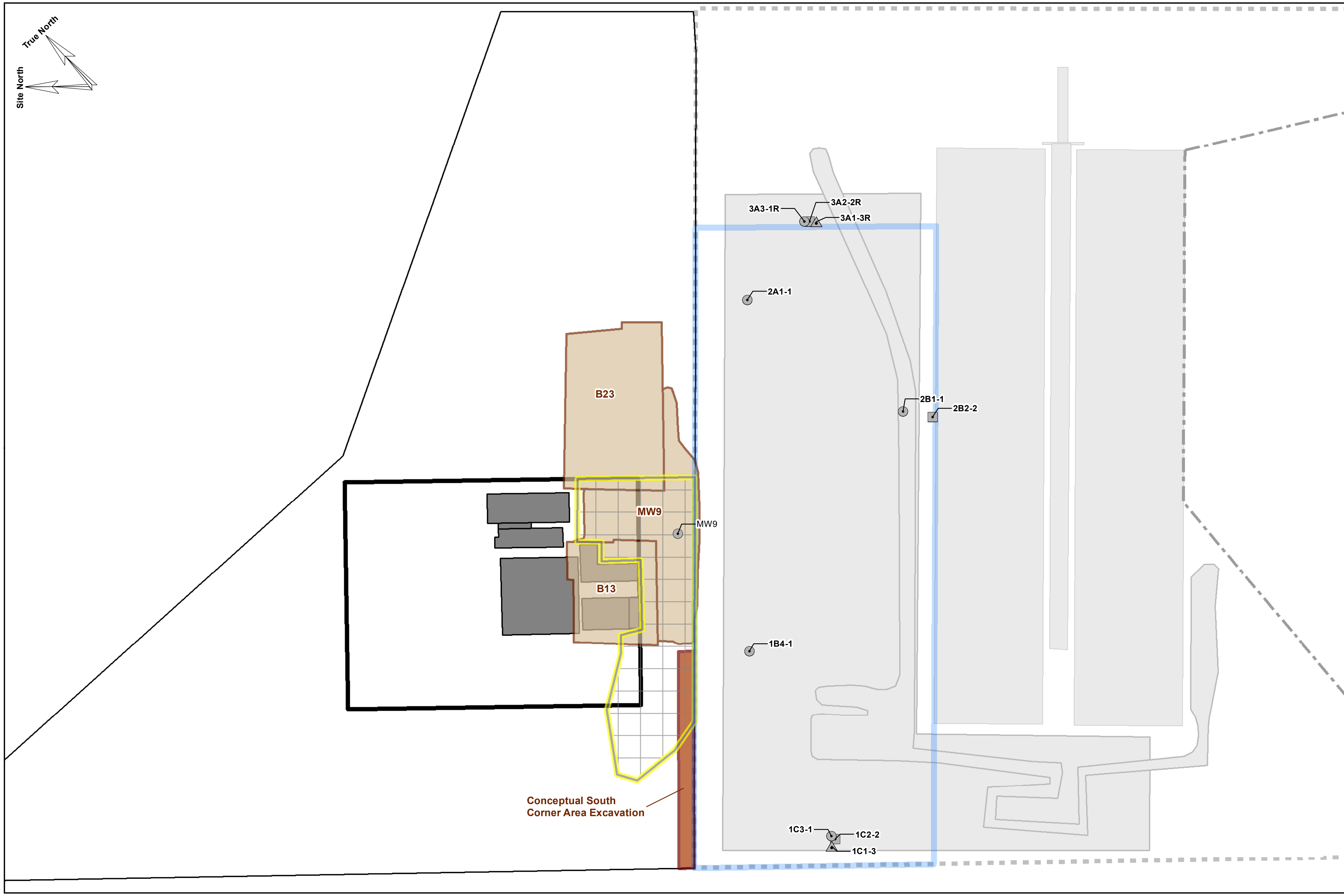
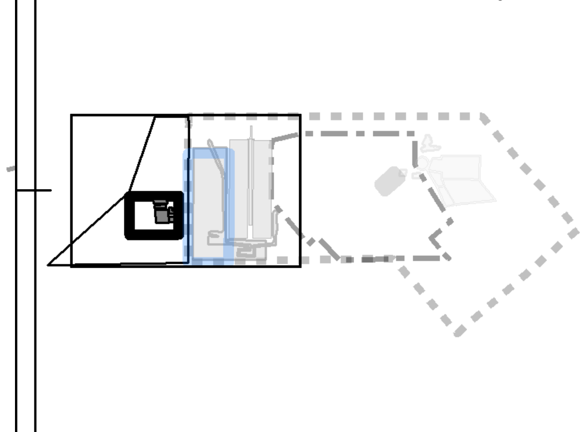
NBA and Adjacent Soil Sampling Locations
NBA Focused FS Report

Figure A-1

Document Path: G:\Projects\Arkema\Maps\NBA FS Report Dec 2021\Fig A-1_NBA and Adjacent USG Soil Sampling Locations.mxd; Author: VN; Date Saved: 12/14/2021



USG / Arkema Site Vicinity



Legend

Aquifer Designation
- Surface Aquifer
- Second Aquifer
- Deep Aquifer

Relevant USG Waste Management
- USG Stockpiles Adjacent to Primary Area of NBA Contamination
- MW9/B13/B23 Excavation
- Conceptual South Corner Area

Former USG Manufacturing
- Former Manufacturing Area
- Other Key Features

Former Arkema
- Former Central Manufacturing
- Other Key Features

Boundaries
- North Boundary
- USG Property Boundary
- Arkema Property Boundary

Notes:
-MW9 was not sampled in 2017
- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

0 75 150 300 Feet

PIONEER TECHNOLOGIES CORPORATION

2017 NBA Groundwater Sampling Locations
NBA Focused FS Report

Figure A-2

Table A-1: Applicable Metals Soil Concentrations in the NBA and Adjacent Areas on the Arkema Property

Category	Sample Location (Site ID)[1,2]	Sample Date	Sample Top (feet bgs)	Sample Bottom (feet bgs)	Soil Concentrations (mg/kg) Arsenic (Lab)	Qualifer	Arsenic (XRF)	Qualifer	Arsenic (CDM Smith Lab) [3]	Qualifer	Lead (Lab)	Qualifer	Lead (XRF)	Qualifer	Lead (CDM Smith Lab) [3]	Qualifer	Copper (Lab)	Qualifer	Mercury (Lab)	Qualifer	Nickel (Lab)	Qualifer
USG Excavation Confirmation Sample Locations	SW24	8/16/1999	2.0	3.0	420						ND						20					
	SW27	8/16/1999	2.0	3.0	250						ND						13					
	SW28	8/16/1999	2.0	3.0	530						15						21					
	SW29	8/16/1999	2.0	3.0	490						32						38					
	SW30	8/16/1999	2.0	3.0	640						14						21					
Arkema Waggoner's Wallow Sample Locations [4]	WWS-1	6/8/1989	1.4	3.2	67						120						110		0.068	U		
	WWS-2	6/8/1989	1.4	2.5	82						220						110		0.26			
	WWS-3	6/8/1989	1.4	3.2	130						260						120		0.10	U		
	WWS-4	6/8/1989	1.4	3.0	150						280						130		0.11	U		
	WWS-5	6/8/1989	1.4	3.7	150						290						100		0.11	U		
	WWS-6	6/8/1989	1.4	2.2	9.2						69						170		0.74			
	WWS-7	6/8/1989	1.4	1.9	13						56						69		0.16			
Arkema Bark Sludge Sample Locations	BSL-10	9/11/1990	0.33	0.50	25						26						44				122	
	BSL-11	9/11/1990	0.33	0.50	28						30						45				133	
	BSL-12	9/11/1990	0.33	0.50	24						27						43				130	
	BSL-13	9/11/1990	0.33	0.50	29						36						159				85	
	BSL-17	9/11/1990	0.33	0.50	21						25						50				119	
	BSL-18	9/11/1990	0.33	0.50	15						27						51				128	
	BSL-2	9/11/1990	0.33	0.50	15						21						41				112	
	BSL-22	9/11/1990	0.33	0.50	31						23						43				102	
	BSL-24	9/11/1990	0.33	0.50	23						28						49				132	
	BSL-25	9/11/1990	0.33	0.50	26						31						53				145	
	BSL-28	9/11/1990	0.33	0.50	39						30						82				161	
	BSL-3	9/11/1990	0.33	0.50	23						28						43				140	
	BSL-32	9/11/1990	0.33	0.50	40						28						49				130	
	BSL-34	9/11/1990	0.33	0.50	28						20						52				117	
	BSL-4	9/11/1990	0.33	0.50	15						25						95				81	
	BSL-40	9/11/1990	0.33	0.50	24						33						57				164	
	BSL-41	9/11/1990	0.33	0.50	39						35						54				132	
	BSL-42	9/11/1990	0.33	0.50	4.0						32						54				137	
	BSL-43	9/11/1990	0.33	0.50	39						32						59				120	
	BSL-45	9/11/1990	0.33	0.50	27						28						48				147	
	BSL-46	9/11/1990	0.33	0.50	26						27						53				145	
	BSL-50	9/11/1990	0.33	0.50	39						27						51				153	
	BSL-51	9/11/1990	0.33	0.50	32						33						59				200	
	BSL-52	9/11/1990	0.33	0.50	37						26						46				145	
	BSL-55	9/11/1990	0.33	0.50	32						24						40				136	
	BSL-56	9/11/1990	0.33	0.50	42						29						46				168	
	BSL-57	9/11/1990	0.33	0.50	30						26						46				150	
	BSL-6	9/11/1990	0.33	0.50	12						20						32				98	
	BSL-7	9/11/1990	0.33	0.50	14						13						26				145	
	BSL-8	9/11/1990	0.33	0.50	22						28						38				102	
Arkema NBA Sample Locations – Other	AT-1	4/11/2003	1.0	4.0	11	U											21		0.29		120	
	AT-1	4/11/2003	12	16	19	U											38		0.48	U	18	
	AT-1	4/11/2003	20	24	13	U											17		0.32	U	9.2	
	AT-2	4/11/2003	1.0	4.0	11	U											32		0.29	U	7.6	
	AT-2	4/11/2003	12	16	13	U											27		0.52	U	10.0	
	AT-2	4/11/2003	20	24	13	U											15		0.33	U	9.3	
	AT-3	4/11/2003	1.0	4.0	18												15		0.27	U	19	
	AT-3	4/11/2003	12	16	17												27		0.42	U	18	
	AT-3	4/11/2003	20	24	13	U											6.8		0.31	U	8.1	
	AT-4	4/11/2003	1.0	4.0	12	U											14		0.30	U	30	
	AT-4	4/11/2003	12	16	15	U											31		0.37	U	17	
	AT-4	4/11/2003	20	24	12	U											16		0.30	U	9.3	
	PT-52	5/4/2007	2.0	2.0	23						61						47	J	0.056		24	
	PT-53	5/8/2007	1.0	1.0	7.4						12						22		0.024	U	10.0	
	PT-54	5/8/2007	1.0	1.0	12	J					25	J					28		0.029		11	
	PT-55	5/8/2007	2.0	2.0	21						21						24		0.025		15	
	PT-56	5/8/2007	1.0	1.0	33						110						96		0.11		28	
	PT-57	5/8/2007	1.0	1.0	9.0						9.7						43		0.030	U	8.6	
	PT-58	5/8/2007	1.0	1.0	7.1						9.6						17		0.026		8.0	
	PT-59	5/8/2007	1.0	1.0	6.7						18						25		0.032		11	
	PT-60	5/8/2007	1.0	1.0	14						24						26		0.073		20	
	PT-61	5/8/2007	1.0	1.0	8.4						18						22		0.032		13	
	SPA-01	4/23/2007	0.0	0.25	3.7						5.6	U					23		0.023	J	18	J
	SPA-01	4/23/2007	0.25	6.0	22						43						25		0.031	J	23	J
	SPA-01	5/29/2007	6.0	10.0	7.8						6.3	U					11		0.025	U	9.1	
	SPA-02	4/23/2007	0.0	0.25	19						28						27		0.082	J	19	J
	SPA-02	4/23/2007	0.25	6.0	13						23						19		0.025	J	11	J
	SPA-03	4/23/2007	0.0	0.25	30						40						45		0.21	J	100	J
	SPA-03	4/23/2007	0.25	6.0	480						160						47		0.074	J	19	J

Table A-1: Applicable Metals Soil Concentrations in the NBA and Adjacent Areas on the Arkema Property

Category	Sample Location (Site ID)[(1,2)]	Sample Date	Sample Top (feet bgs)	Sample Bottom (feet bgs)	Soil Concentrations (mg/kg)																	
					Arsenic (Lab)	Qualifer	Arsenic (XRF)	Qualifer	Arsenic (CDM Smith Lab) [(3)]	Qualifer	Lead (Lab)	Qualifer	Lead (XRF)	Qualifer	Lead (CDM Smith Lab) [(3)]	Qualifer	Copper (Lab)	Qualifer	Mercury (Lab)	Qualifer	Nickel (Lab)	Qualifer
Arkema NBA Sample Locations – Other	SPA-04	4/23/2007	0.0	0.25	14						18						22		0.11	J	19	J
	SPA-04	4/23/2007	0.25	6.0	440						450						96		0.057	J	20	J
	SPA-05	4/23/2007	0.0	0.25	14						22						17		0.12	J	21	J
	SPA-05	4/23/2007	0.25	6.0	38						35						550		0.054	J	28	J
	SPA-06	4/23/2007	0.0	0.25	11						17						23		0.14	J	30	J
	SPA-06	4/23/2007	0.25	6.0	9.5						16	J					12		0.027	UJ	6.7	J
	SPA-07	4/23/2007	0.0	0.25	9.4						13						25		0.16	J	16	J
	SPA-07	4/23/2007	0.25	6.0	5.5						11						24		0.025	UJ	15	J
	SPA-08	4/23/2007	0.0	0.25	14						44						73		0.39	J	36	J
	SPA-08	4/23/2007	0.25	6.0	19						8.1						14		0.027	UJ	10.0	J
	SPA-09	4/23/2007	0.0	0.25	4.4						10						16		0.032	J	13	J
	SPA-09	4/23/2007	0.25	6.0	12						17						17		0.022	UJ	11	J
	SPA-09	5/30/2007	6.0	10.0	6.1						2.9						10		0.024	U	6.6	
	SPA-10	4/23/2007	0.0	0.25	21						37						38		0.15	J	58	J
	SPA-10	4/23/2007	0.25	6.0	57						24						19		0.058	J	19	J
	SPA-11	4/23/2007	0.0	0.25	9.2						18						21		0.084	J	19	J
	SPA-11	4/23/2007	0.25	6.0	45						99						26		0.026	UJ	14	J
	SPA-12	4/23/2007	0.0	0.25	8.7						17						24		0.17	J	13	J
	SPA-12	4/23/2007	0.25	6.0	19						42						23		0.031	J	13	J
	NB-3	7/17/2012	0.0	0.0			14		13				25		37							
	NB-3	7/17/2012	1.5	1.5			8.0	U					14	U								
	NB-3	7/17/2012	2.0	2.0			8.0	U	4.0	U			13	U	12							
	NB-3	7/17/2012	5.0	5.0			8.0	U	4.0	U			13	U	13							
	NB-3	7/17/2012	6.0	6.0			21						12	U								
	NB-3	7/17/2012	7.0	7.0			9.0		24				9.0	U	10.0							
	NB-3	7/17/2012	6.0	8.0	13						4.0						21				10.0	
	NB-3	7/17/2012	11	11			8.0	U	10.0				12	U	10.0							
	NB-4	7/17/2012	0.0	0.0			49		30				40		29							
	NB-4	7/17/2012	0.0	1.0	36						31						67				62	
	NB-4	7/17/2012	2.0	2.0			9.0	U	4.0	U			14	U	13							
	NB-4	7/17/2012	1.0	3.0	5.0	U					4.0						14				11	
	NB-4	7/17/2012	5.0	5.0			8.0	U	6.0				14	U	8.0							
	NB-4	7/17/2012	6.5	6.5			9.0	U	18				12	U	14							
	NB-4	7/17/2012	7.0	7.0			8.0						12	U								
	NB-4	7/17/2012	11	11			44		16				20	U	8.0							
	NB-5	7/17/2012	0.0	0.0			59		76				20		30							
	NB-5	7/17/2012	0.0	0.80	44						24						39				75	
	NB-5	7/17/2012	1.5	2.5	5.0	U					3.0						15				14	
	NB-5	7/17/2012	2.5	2.5			9.0	U	6.0				15	U	7.0							
	NB-5	7/17/2012	5.0	5.0			17		17				10	U	14							
	NB-5	7/17/2012	5.5	5.5			17		23				22		27							
	NB-5	7/17/2012	8.0	8.0			17		13				12	U	10.0							
	NB-5	7/17/2012	10.0	10.0			14		17				14	U	14							
	NB-6	7/18/2012	0.0	0.0			19		27				46		34							
	NB-6	7/18/2012	2.5	2.5			8.0	U	5.0				12	U	11							
	NB-6	7/18/2012	1.0	3.0	6.0						6						20				12	
	NB-6	7/18/2012	5.0	5.0			31		96				18		39							
	NB-6	7/18/2012	6.0	6.0			34		6.0				8.0	U	10.0							
	NB-6	7/18/2012	6.5	6.5			8.0						12	U								
	NB-6	7/18/2012	10.0	10.0			16		155				42		305							
	NB-6	7/18/2012	11	11			9.0	U					14									
	NB-7	7/17/2012	0.0	0.0			16		41				50		52							
	NB-7	7/17/2012	2.5	2.5			49		43				110		116							
	NB-7	7/17/2012	2.0	3.5	26						80						65				24	
	NB-7	7/17/2012	5.0	5.0			34		55				15	U	20							
	NB-7	7/17/2012	6.5	6.5			8.0	U	11				14		12							
	NB-7	7/17/2012	10.0	10.0			20		22				14	U	10.0							
	NB-8	7/18/2012	0.0	0.0			22		24				27		28							
	NB-8	7/18/2012	1.8	1.8			88		158				96		122							
	NB-8	7/18/2012	1.0	2.0	67						49						52				27	
	NB-8	7/18/2012	2.0	2.0			101		72				109		95							
	NB-8	7/18/2012	5.0	5.0			11		7.0				12	U	13							
	NB-8	7/18/2012	5.0	5.5	12						12						40				16	
	NB-8	7/18/2012	7.0	7.0			11		4.0				12	U	6.0							
	NB-8	7/18/2012	10.0	10.0			9.0	U	4.0	U			18	U	7.0							
	NB-8	7/18/2012	10.0	11	6.0	U					2.0	U					8.0				6.0	
	NB-9	7/17/2012	0.0	0.0			27		26				73		67							
	NB-9	7/17/2012	1.5	1.5			30						10	U								
	NB-9	7/17/2012	2.0	2.0			13		8.0				13	U	11							
	NB-9	7/17/2012	5.0	5.0			8.0	U	5.0				13	U	7.0							
	NB-9	7/17/2012	6.5	6.5			14		28				13	U	7.0							

Table A-1: Applicable Metals Soil Concentrations in the NBA and Adjacent Areas on the Arkema Property

Category	Sample Location (Site ID)[(1,2)]	Sample Date	Sample Top (feet bgs)	Sample Bottom (feet bgs)	Soil Concentrations (mg/kg) Arsenic (Lab)	Qualifer	Arsenic (XRF)	Qualifer	Arsenic (CDM Smith Lab) [(3)]	Qualifer	Lead (Lab)	Qualifer	Lead (XRF)	Qualifer	Lead (CDM Smith Lab) [(3)]	Qualifer	Copper (Lab)	Qualifer	Mercury (Lab)	Qualifer	Nickel (Lab)	Qualifer
Arkema NBA Sample Locations – Other	NB-9	7/17/2012	11	11			19		59				12	U	8.0							
	NB-10	7/17/2012	0.0	0.0			31		44				24		39							
	NB-10	7/17/2012	3.0	3.0			9.0		11				13	U	9.0							
	NB-10	7/17/2012	5.2	5.2			9.0	U					16									
	NB-10	7/17/2012	5.5	5.5			2,682		3,512				9,184		8,276							
	NB-10	7/17/2012	5.5	5.6	754						2,270						566				37	
	NB-10	7/17/2012	5.7	5.7			52						12	U								
	NB-10	7/17/2012	6.0	6.0			19						12	U								
	NB-10	7/17/2012	5.6	6.0	66						3.0						15				7.0	
	NB-10	7/17/2012	7.0	7.0			7.0	U	10.0				5.0	U	7.0							
	NB-10	7/17/2012	8.5	8.5			7.0	U	12				11	U	21							
	NB-10	7/17/2012	11	11			17		12				11	U	9.0							
	NB-10	7/17/2012	10.0	12	10.0						2.0	U					8.9				6.0	
	NB-11	7/16/2012	0.0	0.0			57		76				59		55							
	NB-11	7/16/2012	0.0	1.0	22						23						36				38	
	NB-11	7/16/2012	5.0	5.0			16		19				36		42							
	NB-11	7/16/2012	6.5	6.5			3,009		3,525				10,474		9,317							
	NB-11	7/16/2012	7.0	7.0			33		113				12	U	9.0							
	NB-11	7/16/2012	6.5	7.0	1,660						2,620						683				89	
	NB-11	7/16/2012	7.0	8.0	52						3.0						13				6.0	
	NB-11	7/16/2012	10.0	10.0			9.0		15				11	U	16							
	NB-11	7/16/2012	13	13			82		203				10	U	9.0							
	NB-13	7/16/2012	0.0	0.0			68		82				67		74							
	NB-13	7/16/2012	1.5	1.5			8.0	U					14									
	NB-13	7/16/2012	5.0	5.0			9.0		6.0				12	U	21							
	NB-13	7/16/2012	6.0	6.0			628		2,662				731		4,884							
	NB-13	7/16/2012	6.5	6.5	805		705		1,786		901		218		1,212		278				16	
	NB-13	7/16/2012	8.0	8.0			62		131				11	U	17							
	NB-13	7/16/2012	7.0	8.0	198						6.0						37				12	
	NB-13	7/16/2012	11	11			57						12	U								
	NB-13	7/16/2012	12	12			86		184				12		11							
	NB-13	7/16/2012	14	14			15						12	U								
	NB-14	7/17/2012	0.0	0.0			58		87				65		66							
	NB-14	7/17/2012	2.0	2.0			14		14				14	U	27							
	NB-14	7/17/2012	2.0	4.0	5.0	U					6.0						16				14	
	NB-14	7/17/2012	5.0	5.0			314		477				82		934							
	NB-14	7/17/2012	6.0	6.0			9.0	U					18									
	NB-14	7/17/2012	5.0	6.0	167						165						46				10.0	
	NB-14	7/17/2012	6.5	6.5			151		256				14		24							
	NB-14	7/17/2012	7.0	8.0	35						13						38				13	
	NB-14	7/17/2012	10.0	10.0			14		30				13	U	8.0							
	NB-15	7/16/2012	0.0	0.0			17		22				37		39							
	NB-15	7/16/2012	2.5	2.5			12		8.0				11		13							
	NB-15	7/16/2012	6.0	6.5	2,890						2,740						617				58	
	NB-15	7/16/2012	6.5	6.5			4,653		3,544				2,077		4,288							
	NB-15	7/16/2012	8.0	8.0			3,148		1,932				29		17							
	NB-15	7/16/2012	7.0	9.0	811						10						27				10.0	
	NB-15	7/16/2012	10.0	10.0			117		287				12	U	17							
	NB-15	7/16/2012	12	12			81		125				12	U	9.0							
	NB-15	7/16/2012	11	12	117						5.0						12				7.0	
	NB-16	7/17/2012	0.0	0.0			13		21				24		26							
	NB-16	7/17/2012	2.0	2.0			68		196				25		411							
	NB-16	7/17/2012	5.0	5.0			30						79									
	NB-16	7/17/2012	5.4	5.4			1,800		3,583				2,588		3,940							
	NB-16	7/17/2012	5.3	5.5	1,800						1,440						332				58	
	NB-16	7/17/2012	6.0	6.0			433		1,525				12	U	37							
	NB-16	7/17/2012	7.0	7.0			97						16									
	NB-16	7/17/2012	8.0	8.0			1,211		486				12	U	22							
	NB-16	7/17/2012	8.2	8.2			31						13	U								
	NB-16	7/17/2012	7.0	8.5	82						13						44				15	
	NB-16	7/17/2012	10.0	10.0			40						13	U								
	NB-16	7/17/2012	11	11			23		64				11	U	7.0							
	NB-17	7/17/2012	0.0	0.0			17		21				29		31							
	NB-17	7/17/2012	2.0	2.0			24		57				27		43							
	NB-17	7/17/2012	5.0	5.0			22		27				13	U	12							
	NB-17	7/17/2012	6.0	6.0	3,770		1,348		7,331		4,070		790		6,827		590				41	
	NB-17	7/17/2012	7.0	7.0			706		960				37		18							
	NB-17	7/17/2012	9.0	9.0			264		1,398				14	U	20							
	NB-17	7/17/2012	12	12			316		457				12	U	9.0							
	NB-17	7/17/2012	10.0	12	192						3.0						9.1				8.0	
	NB-18	7/17/2012	0.0	0.0			129		48				20		26							

Table A-1: Applicable Metals Soil Concentrations in the NBA and Adjacent Areas on the Arkema Property

Category	Sample Location (Site ID)[1,2]	Sample Date	Sample Top (feet bgs)	Sample Bottom (feet bgs)	Soil Concentrations (mg/kg) Arsenic (Lab)	Qualifer	Arsenic (XRF)	Qualifer	Arsenic (CDM Smith Lab) [3]	Qualifer	Lead (Lab)	Qualifer	Lead (XRF)	Qualifer	Lead (CDM Smith Lab) [3]	Qualifer	Copper (Lab)	Qualifer	Mercury (Lab)	Qualifer	Nickel (Lab)	Qualifer
Arkema NBA Sample Locations – Other	NB-18	7/17/2012	1.5	1.5			57						46									
	NB-18	7/17/2012	2.0	2.0			28		13				25		19							
	NB-18	7/17/2012	5.0	5.0			135		258				20		36							
	NB-18	7/17/2012	5.0	5.5	170						42						48				14	
	NB-18	7/17/2012	6.5	6.5			13		10.0				11	U	7.0							
	NB-18	7/17/2012	5.5	7.0	11						2.0	U					7.6				6.0	
	NB-18	7/17/2012	10.0	10.0			8.0	U	10.0				13	U	10.0							
	NB-18	7/17/2012	11	11			17		18				12	U	7.0							
	NB-18	7/17/2012	10.0	12	11						2.0	U					10				7.0	
	NB-19	7/18/2012	0.0	0.0			26		34				41		38							
	NB-19	7/18/2012	1.0	1.0			27						14									
	NB-19	7/18/2012	2.0	2.0			9.0	U	7.0				14		21							
	NB-19	7/18/2012	5.0	5.0			20		29				11	U	9.0							
	NB-19	7/18/2012	6.0	6.0			12		14				11	U	8.0							
	NB-19	7/18/2012	10.0	10.0			64		108				51		71							
	NB-20	7/17/2012	0.0	0.0			43		56				16		25							
	NB-20	7/17/2012	0.50	0.50			34						45									
	NB-20	7/17/2012	0.0	1.0	90						57						87				195	
	NB-20	7/17/2012	1.5	1.5			8.0	U					13	U								
	NB-20	7/17/2012	3.0	3.0			20		12				18		14							
	NB-20	7/17/2012	5.0	5.0			39		60				13		21							
	NB-20	7/17/2012	5.0	6.0	69						13						63				25	
	NB-20	7/17/2012	7.0	7.0			8.0	U	18				12	U	6.0							
	NB-20	7/17/2012	11	11			11		13				12	U	12							
	NB-21	7/18/2012	0.0	0.0			46		45				56		48							
	NB-21	7/18/2012	2.0	2.0			8.0	U					13	U								
	NB-21	7/18/2012	3.0	3.0			23		37				13		33							
	NB-21	7/18/2012	5.0	5.0			30		21				27		24							
	NB-21	7/18/2012	5.0	6.0	16						15						56				26	
	NB-21	7/18/2012	7.0	7.0			8.0		16				10	U	15							
	NB-21	7/18/2012	10.0	10.0			7.0	U	10.0				12	U	8.0							
	NB-22	7/18/2012	0.0	0.0			12	U	18				32		28							
	NB-22	7/18/2012	2.0	2.0			76		40				48		65							
	NB-22	7/18/2012	2.0	3.0	34						39						42				24	
	NB-22	7/18/2012	5.0	5.0			62		49				19		64							
	NB-22	7/18/2012	6.5	6.5			8.0	U	4.0	U			13	U	8.0							
	NB-22	7/18/2012	10.0	10.0			7.0	U	5.0				12	U	6.0							
	NB-22	7/18/2012	12	12			7.0	U	4.0	U			11	U	10.0							
	NB-23	7/16/2012	0.0	0.0			17		18				32		21							
	NB-23	7/16/2012	0.0	1.0	17						18						23				19	
	NB-23	7/16/2012	2.5	2.5			11		72				13	U	44							
	NB-23	7/16/2012	5.0	5.0			8.0	U	4.0	U			17		17							
	NB-23	7/16/2012	5.0	6.0	7.0	U					7.0						21				12	
	NB-23	7/16/2012	6.5	6.5			6.0	U	12				10	U	9.0							
	NB-23	7/16/2012	11	11			6.0	U	4.0	U			10	U	8.0							
	NB-24	7/16/2012	0.0	0.0			20		25				22		23							
	NB-24	7/16/2012	2.0	2.0			57		61				22		67							
	NB-24	7/16/2012	2.0	3.5	19						32						29				23	
	NB-24	7/16/2012	5.0	5.0			7.0	U	5.0				12	U	14							
	NB-24	7/16/2012	7.0	7.0			8.0	U	14				12	U	11							
	NB-24	7/16/2012	12	12			6.0	U	4.0	U			10	U	8.0							
	NB-25	7/16/2012	0.0	0.0			18		14				20		22							
	NB-25	7/16/2012	3.0	3.0			8.0	U	6.0				13	U	14							
	NB-25	7/16/2012	5.0	5.0			1,281		885				13	U	20							
	NB-25	7/16/2012	5.0	6.0	1,200						12						36				13	
	NB-25	7/16/2012	7.5	7.5			125		304				11	U	14							
	NB-25	7/16/2012	10.0	10.0			57		528				58		45							
	NB-25	7/16/2012	12	12			116		2.0				13	U	8.0							
	NB-26	7/16/2012	0.0	0.0			13		27				31		28							
	NB-26	7/16/2012	0.0	1.0	12						17						19				18	
	NB-26	7/16/2012	3.0	3.0			7.0	U	13				12	U	14							
	NB-26	7/16/2012	6.5	6.5	1,700		2,717		5,192		1,260		13		5,615		269				40	
	NB-26	7/16/2012	8.0	8.0			797		2,217				23		33							
	NB-26	7/16/2012	10.0	10.0			2,603		2,269				16		40							
	NB-26	7/16/2012	10.0	10.0			1,234						19									
	NB-26	7/16/2012	10.0	11	1,150						16						43				18	
	NB-30	7/15/2012	0.0	0.0			14		13				30		21							
	NB-30	7/15/2012	1.5	1.5			42		16				25		20							
	NB-30	7/15/2012	2.5	2.5			8.0	U	4.0	U			13	U	7.0							
	NB-30	7/15/2012	6.5	6.5			302		398				13	U	10.0							
	NB-30	7/15/2012	6.0	8.0	116						2.0	U					10				6.0	

Table A-1: Applicable Metals Soil Concentrations in the NBA and Adjacent Areas on the Arkema Property

Category	Sample Location (Site ID)[1,2]	Sample Date	Sample Top (feet bgs)	Sample Bottom (feet bgs)	Soil Concentrations (mg/kg) Arsenic (Lab)	Qualifer	Arsenic (XRF)	Qualifer	Arsenic (CDM Smith Lab) [3]	Qualifer	Lead (Lab)	Qualifer	Lead (XRF)	Qualifer	Lead (CDM Smith Lab) [3]	Qualifer	Copper (Lab)	Qualifer	Mercury (Lab)	Qualifer	Nickel (Lab)	Qualifer
Arkema NBA Sample Locations – Other	NB-30	7/15/2012	9.0	9.0			29		52				12	U	13							
	NB-30	7/15/2012	12	12			7.0	U	7.0				11	U	9.0							
	NB-31	7/16/2012	0.0	0.0			16		20				32		30							
	NB-31	7/16/2012	1.5	1.5			11		5.0				11	U	9.0							
	NB-31	7/16/2012	4.9	4.9			452						105									
	NB-31	7/16/2012	5.0	5.0			1,647		3,161				2,973		3,626							
	NB-31	7/16/2012	5.3	5.3	2,210						3,120						614				53	
	NB-31	7/16/2012	6.0	6.0			203		343				11	U	11							
	NB-31	7/16/2012	7.0	7.0			17		35				12	U	13							
	NB-31	7/16/2012	12	12			7.0	U	5.0				12	U	8.0							
	NB-32	7/16/2012	0.0	0.0			26		21				16		28							
	NB-32	7/16/2012	1.5	1.5			8.0	U	4.0	U			12	U	10.0							
	NB-32	7/16/2012	1.5	2.5	6.0	U					4.0						24				23	
	NB-32	7/16/2012	5.0	5.0			15		45				13	U	14							
	NB-32	7/16/2012	5.0	6.0	58						85						25				9.0	
	NB-32	7/16/2012	7.0	7.0			7.0	U	6.0				14		21							
	NB-33	7/16/2012	0.0	0.0			19		32				20		31							
	NB-33	7/16/2012	2.0	2.0			12		47				14	U	55							
	NB-33	7/16/2012	3.5	3.5			12		8.0				13	U	14							
	NB-33	7/16/2012	2.0	4.0	33						26						106				82	
	NB-33	7/16/2012	6.0	6.0			27		34				12	U	10.0							
	NB-33	7/16/2012	9.0	9.0			7.0	U	4.0	U			12	U	10.0							
	NB-33	7/16/2012	12	12			7.0	U	4.0	U			12	U	11							
	NB-34	7/15/2012	0.0	0.0			13		21				35		36							
	NB-34	7/15/2012	2.0	2.0			25						53									
	NB-34	7/15/2012	2.0	2.5	456						610						88				16	
	NB-34	7/15/2012	2.5	2.5			73		53				105		62							
	NB-34	7/15/2012	6.0	6.0					9.0						16							
	NB-34	7/15/2012	7.0	7.0			8.0	U	11				12	U	15							
	NB-34	7/15/2012	9.0	9.0			8.0	U	6.0				12	U	14							
	NB-34	7/15/2012	11	11					4.0	U					9.0							
	NB-34	7/15/2012	12	12			7.0	U					12	U								
	NB-35	7/15/2012	0.0	0.0			7.0	U	29				11	U	37							
	NB-35	7/15/2012	1.0	1.0			20	U					240									
	NB-35	7/15/2012	1.5	1.5	261		911				884		3,724				170				32	
	NB-35	7/15/2012	2.0	2.0					432						939							
	NB-35	7/15/2012	2.5	2.5			56						20									
	NB-35	7/15/2012	2.0	4.0	13						2	U					10				6.0	
	NB-35	7/15/2012	4.0	4.0			10		13				14	U	8.0							
	NB-35	7/15/2012	6.0	6.0			8.0	U	4.0	U			12	U	10.0							
	NB-35	7/15/2012	7.5	7.5			12						15									
	NB-35	7/15/2012	8.0	8.0			7.0	U	10.0				12	U	24							
	NB-35	7/15/2012	10.0	10.0			7.0	U	4.0	U			11	U	9.0							
	NB-36	7/15/2012	0.0	0.0			18		13				34		25							
	NB-36	7/15/2012	2.0	2.0	250		124		85		839		307		131		151				20	
	NB-36	7/15/2012	2.5	2.5			78		65				70		10.0							
	NB-36	7/15/2012	5.0	5.0					61						14							
	NB-36	7/15/2012	6.0	6.0			8.0	U	14				13		17							
	NB-36	7/15/2012	11	11			8.0		6.0				12	U	8.0							
	NB-37	7/15/2012	0.0	0.0			15		17				21		30							
	NB-37	7/15/2012	0.0	1.0	59						53						64				133	
	NB-37	7/15/2012	2.5	2.5	281		1,288				1,220		5,975				204				29	
	NB-37	7/15/2012	3.0	3.0			44		65				13	U	11							
	NB-37	7/15/2012	6.0	6.0			7.0	U					13	U								
	NB-37	7/15/2012	9.0	9.0			11		12				11	U	11							
	NB-37	7/15/2012	11	11			8.0	U	10.0				17		14							
	NB-37	7/15/2012	12	12			7.0	U	6.0				13	U	12							
	NB-38	7/15/2012	0.0	0.0			24		26				24		31							
	NB-38	7/15/2012	0.0	1.0	40						37						54				105	
	NB-38	7/15/2012	1.0	1.0			37						33									
	NB-38	7/15/2012	1.5	1.5			17		39				15		34							
	NB-38	7/15/2012	3.0	3.0			40		58				11	U	6.0							
	NB-38	7/15/2012	6.5	6.5			10		16				17		14							
	NB-38	7/15/2012	5.0	7.0	35						3.0	U					18				9.0	
	NB-38	7/15/2012	8.0	8.0			7.0	U	4.0	U			18		18							
	NB-42	7/15/2012	0.0	0.0			37		47				43		30							
	NB-42	7/15/2012	1.5	1.5			57						12	U								
	NB-42	7/15/2012	2.0	2.0	1,730		873		255		1,840		571		112		368				35	
	NB-42	7/15/2012	3.0	3.0			8.0	U	40				13	U	19							
	NB-42	7/15/2012	7.0	7.0			7.0	U	6.0				11	U	20							
	NB-42	7/15/2012	9.0	9.0			9.0	U	5.0				30		24							

Table A-1: Applicable Metals Soil Concentrations in the NBA and Adjacent Areas on the Arkema Property

Category	Sample Location (Site ID)[1,2]	Sample Date	Sample Top (feet bgs)	Sample Bottom (feet bgs)	Soil Concentrations (mg/kg) Arsenic (Lab)	Qualifer	Arsenic (XRF)	Qualifer	Arsenic (CDM Smith Lab) [3]	Qualifer	Lead (Lab)	Qualifer	Lead (XRF)	Qualifer	Lead (CDM Smith Lab) [3]	Qualifer	Copper (Lab)	Qualifer	Mercury (Lab)	Qualifer	Nickel (Lab)	Qualifer
Arkema NBA Sample Locations – Other	NB-42	7/15/2012	10.0	10.0			9.0	U					14	U								
	NB-42	7/15/2012	12	12			7.0	U	4.0	U			17		10.0							
	NB-43	7/15/2012	0.0	0.0			11		10.0				18		24							
	NB-43	7/15/2012	1.0	1.0			9.0	U					15									
	NB-43	7/15/2012	0.50	1.5	9.0						6.0						22				31	
	NB-43	7/15/2012	1.5	1.5			55						25									
	NB-43	7/15/2012	2.0	2.0			21		53				14	U	46							
	NB-43	7/15/2012	3.0	3.0			28		109				12	U	168							
	NB-43	7/15/2012	6.0	6.0			24		31				12	U	9.0							
	NB-43	7/15/2012	9.5	9.5			6.0	U					9.0	U								
	NB-43	7/15/2012	12	12			8.0	U	4.0	U			15		13							
	NB-43	7/15/2012	10.0	12	11						11						40				18	
	NB-44	7/15/2012	0.0	0.0			29		39				14	U	40							
	NB-44	7/15/2012	1.0	1.0			28		52				45		53							
	NB-44	7/15/2012	1.0	2.0	6.0						3.0						22				31	
	NB-46	7/18/2012	0.0	0.0			12						21									
	NB-46	7/18/2012	1.0	1.0			37		33				73		105							
	NB-46	7/18/2012	5.0	5.0			100						68									
	NB-46	7/18/2012	6.0	6.0			141		419				48		81							
	NB-46	7/18/2012	5.0	7.0	368						78						78				21	
	NB-46	7/18/2012	7.0	7.0			154		139				35		40							
	NB-46	7/18/2012	10.0	10.0			569		215				31		63							
	NB-46	7/18/2012	11	11			33						13	U								
	NB-46	7/18/2012	10.0	11	19						3.0						31				13	
	NB-46	7/18/2012	11	11			50		93				33		71							
	NB-46	7/18/2012	12	12			7.0	U	4.0	U			12	U	9.0							
	NB-46	7/18/2012	12	13	142						42						62				18	
	NB-47	7/18/2012	0.0	0.0			37		77				76		127							
	NB-47	7/18/2012	1.8	1.8			16		333				42		238							
	NB-47	7/18/2012	4.0	4.0			123						24									
	NB-47	7/18/2012	4.5	4.5			261						11	U								
	NB-47	7/18/2012	4.0	5.0	121						20						64				22	
	NB-47	7/18/2012	5.0	5.0			31		132				16		31							
	NB-47	7/18/2012	6.0	6.0			28		63				14	U	18							
	NB-47	7/18/2012	8.0	8.0			5.0	U	5.0				8	U	13							
	NB-47	7/18/2012	10.0	10.0			7.0		16				10	U	10.0							
	NB-47	7/18/2012	12	12			8.0	U	4.0	U			13	U	9.0							
	NB-48	7/18/2012	0.0	0.0			64		51				96		55							
	NB-48	7/18/2012	1.5	1.5			40						18									
	NB-48	7/18/2012	2.0	2.0			83		328				45		484							
	NB-48	7/18/2012	1.5	2.5	199						305						84				50	
	NB-48	7/18/2012	5.0	5.0			53		8.0				66		14							
	NB-48	7/18/2012	6.0	6.0			37						11	U								
	NB-48	7/18/2012	7.0	7.0			8.0	U	11				13	U	7.0							
	NB-48	7/18/2012	6.0	7.5	6.0	U					2.0	U					8.1				5.0	
	NB-48	7/18/2012	10.0	10.0			7.0	U	5.0				13	U	8.0							
	NB-49	7/18/2012	0.0	0.0			23		47				22		41							
	NB-49	7/18/2012	0.80	0.80			12						12	U								
	NB-49	7/18/2012	1.0	1.0	787		686		898		1,850		1,592		1,452		345				40	
	NB-49	7/18/2012	1.5	1.5			8.0	U					13	U								
	NB-49	7/18/2012	1.0	2.0	15						5.0						11				6.0	
	NB-49	7/18/2012	5.0	5.0			10	U	7.0				6.0	U	10.0							
	NB-49	7/18/2012	5.0	6.0	12						2.0	U					14				7.0	
	NB-49	7/18/2012	7.0	7.0			7.0	U	7.0				12	U	17							
	NB-49	7/18/2012	8.0	8.0			13		7.0				21		24							
		Maximum Concentration (mg/kg)			7,331						10,474						683		0.74		200	

Notes:

J: Estimated value

ND: Not detected and reporting limit was not avalable.

U: Not detected at shown reporting limit.

The sources for these results are as follows: SW-series from AGI Technologies 2000, WWS-series from Kennedy/Jenks/Chilton 1990, BSL-series from Boateng 1990, AT-series from Boateng 2003, PT-series and SPA-series from Malcolm Pirnie 2007, and NB-series from DOF 2013 and CDM Smith 2016.

Concentrations are shown as two significant figures in standard notation unless that number is greater than 100. If greater than 100, the number is rounded to a whole number.

(1) If the cell is blank for a given constituent, that means the sample was not analyzed for that constituent.

(2) See Figure A-1 for the locations of these samples (Site IDs).

(3) CDM Smith also collected separate soil samples from 2012 NBA soil borings for lab analyses.

(4) The sample depths for the 1989 Waggoner's Wallow samples WWS-1 through WWS-7 account for the fact that a soil cap/cover was placed on top of the soil sample interval in circa 1990. The current sample top is assumed to be the average (1.4 feet) of the estimated cap/cover thickness (0.4 to 2.4 feet).

Table A-2: 2017 Arsenic, Copper, Mercury and Nickel Groundwater Concentrations in the NBA

Aquifer	Sample Location (Site ID)[1]	Sample Date	Dissolved Groundwater Concentrations (ug/L)							
			Arsenic	Qualifer	Copper	Qualifer	Mercury	Qualifer	Nickel	Qualifer
Surface	1B4-1	10/26/2017	52		15		0.10	U	18	
	1C3-1	10/11/2017	751		2.5	U	0.10	U	1.4	J
	2A1-1	10/13/2017	90		1.0	U	0.20	U	4.1	
	2B1-1	10/13/2017	147		13		0.20	U	11	
	3A3-1R	10/16/2017	58		1.3	J	0.0041		5.6	
Second	1C2-2	10/11/2017	5.2		10	U	0.10	U	2.1	J
	2B2-2	10/13/2017	15	J	10	U	0.20	U	10	U
	3A2-2R	10/16/2017	3.4		2.7	U	0.00049		0.61	
Deep	1C1-3	11/3/2017	1.3		1.0	U	0.10	U	5.5	
	3A1-3R	11/2/2017	1.6	U	2.7	U	0.00040	U	0.61	U
Maximum Detected Concentration (ug/L)			751		15		0.0041		18	

Notes:

J: Estimated value

U: Not detected at shown reporting limit.

These 2017 groundwater sampling results are from a larger groundwater sampling event conducted on the Arkema Property (see PIONEER 2019).

Concentrations are shown as two significant figures in standard notation unless that number is greater than 100. If greater than 100, the number is rounded to a whole number.

[1] See Figure A-2 for the locations of these samples (Site IDs).

Appendix B

Table B-1: Preliminary Evaluation of Potentially Applicable or Relevant and Appropriate Requirements (ARARs) for Cleanup Action Implementation

Type	Law/Regulation/Requirement	Brief Synopsis of Law/Regulation/Requirement	Chemical	Location	Action	ARAR?	Comment for Cleanup Action Implementation
Cleanup and Waste Management	State Model Toxics Control Act (Chapter 70.105D RCW, Chapter 173-340 WAC)	Processes and standards are used to identify, investigate, and cleanup sites where hazardous substances are located.	✓		✓	Yes	MTCA regulations are the primary requirement for developing cleanup standards and implementing the cleanup action. ARARs that were already used to develop cleanup levels (e.g., surface water protection ARARs) are not repeated in this table.
	Federal Resource Conservation and Recovery Act (42 USC 6901 et seq., 40 CFR 257-268)	The characterization, generation, transportation, treatment, storage, and disposal of hazardous solid wastes are regulated (Subtitle C), and minimum national guidelines exist for management of non-hazardous solid wastes (Subtitle D).	✓		✓	Yes	The characterization, generation, transportation, treatment, storage, and disposal of solid waste generated during cleanup action implementation will be conducted in accordance with applicable federal, state, and local waste management regulations. All solid waste generated during cleanup action implementation will be disposed of at an off-site facility permitted to receive the waste.
	State Hazardous Waste Management (Chapter 70.105 RCW, Chapter 173-303 WAC)	The state's regulation for the characterization, generation, transportation, treatment, storage, and disposal of hazardous solid wastes defined in Resource Conservation and Recovery Act Subtitle C and additional dangerous solid wastes defined in Chapter 173-303 WAC.	✓		✓	Yes	
	State Solid Waste Management (Chapter 70.95 RCW, Chapter 173-350 WAC, Chapter 173-304 WAC)	The state's regulation for the management of non-hazardous and non-dangerous solid waste.			✓	Yes	
	Federal Hazardous Materials Transportation (49 USC 5101 et seq., 49 CFR Parts 171-180)	Requirements exist (e.g., packaging, labeling, placarding, communications, emergency response) for the transportation of hazardous materials, including hazardous waste.	✓		✓	Yes	The transportation of any hazardous materials generated during cleanup action implementation will comply with these regulations.
	State Sediment Management Standards (Chapter 70.105D RCW, Chapter 90.48 RCW, various other RCW chapters, Chapter 173-204 WAC)	Processes and standards are used to serve as the basis for making decisions about pollutant discharges that affect surface sediments and the cleanup of contaminated surface sediments.	✓		✓	No	This is not an ARAR for cleanup action implementation since there is no contaminated surface sediment associated with the NBA.
	State Dredge Materials Management (various RCW chapters, Chapter 332-30-166 WAC)	Requirements exist for open water disposal of dredged material obtained from marine or fresh waters.			✓	No	This is not an ARAR because sediment dredging is not a remedial component of any cleanup action alternative.
Worker Health and Safety	Federal Occupational Safety and Health Standards (various laws, 29 CFR 1910)	Development and enforcement of national safety standards are used to establish safe and healthful working conditions for workers, including hazardous waste operations and emergency response workers in 29 CFR 1910.120.	✓		✓	Yes	Cleanup action implementation will be conducted in accordance with applicable federal and state safety and health regulations. For instance, cleanup action implementation fieldwork will be conducted in accordance with a project-specific health and safety plan.
	Federal Construction Safety and Heath (Contract Work Hours and Safety Standards Act, 29 CFR 1926)	Development and enforcement of national safety standards are used to establish safe and healthful working conditions for construction workers.			✓	Yes	
	State Industrial Safety and Health Act (Chapter 49.17 RCW, various Chapter 296 WACs)	Development and enforcement of state safety standards are used to establish safe and healthful working conditions for workers, including hazardous waste operations workers (Chapter 296-843 WAC) and construction workers (Chapter 296-155 WAC).	✓		✓	Yes	
Biological and Cultural Resources	Federal Endangered Species Act (16 USC 1531 et seq., 50 CFR 17, 50 CFR 402)	The taking of any listed endangered species is prohibited. In addition, federal agencies are required to ensure that any federally funded or permitted project is not likely to jeopardize the continued existence or adversely effect critical habitat for a listed endangered species.		✓		Yes	Although it is highly unlikely that any remedial components in the cleanup action alternatives would result in the take of an endangered species, migratory bird species, bald eagle, or golden eagle, the potential for adversely affecting these species will be assessed during remedial design.
	Federal Migratory Bird Treaty Act (16 USC 703 et seq., 50 CFR 10.13)	The taking of a migratory bird species is prohibited without a permit.		✓		Yes	
	Federal Bald and Golden Eagle Protection Act (16 USC 668 et seq., 50 CFR 22)	The taking (e.g., pursuing, killing, capturing, collecting, disturbing) of a bald or golden eagle, including their parts, nests, or eggs, is prohibited without a permit.		✓		Yes	
	State Bald Eagle Protection Rules (Chapter 77.12.655 RCW, Chapter 220-610-100 WAC)	Requirements exist to protect bald eagle habitat by promoting cooperative land management efforts that incorporate eagle habitat needs.		✓		Yes	
	Federal Fish and Wildlife Coordination Act (16 USC. 661 et seq., 33 CFR 320-330)	Coordination with federal and state fish and wildlife agencies is required to ensure adequate protection of fish and wildlife resources for any federally funded or permitted project that proposes to modify a water body.		✓		No	This is not an ARAR for cleanup action implementation since no water bodies will be modified by any of the cleanup action alternatives.
	Federal Historic Preservation Act (54 USC 300101 et seq., 36 CFR Part 800)	Federal agencies are required to take into account the effect of an action upon any district, site, building, structure, or object that is included in or eligible for the National Register of Historic Places (generally 50 years old or older).		✓		Yes	The potential for cultural resources to be encountered during cleanup action implementation will be assessed prior to conducting any ground-disturbing activities (which include advancing soil borings and conducting soil excavations). The Port has submitted an Ecology Cultural Resources Review Form to Ecology for the Arkema Property and has conducted cultural resources assessment activities for other past projects in the vicinity of the NBA. The Port will prepare and submit a NBA-specific Ecology Cultural Resources Review Form and a NBA-specific Inadvertent Discovery Plan to Ecology prior to implementing any ground-disturbing activities. The Port will also (1) conduct additional cultural resource assessment activities (e.g., consult with tribes and DAHP, conduct additional cultural resources research) for the NBA as necessary, (2) implement any measures that are determined to be necessary for NBA ground-disturbing activities (e.g., monitoring by an archaeologist), and (3) implement procedures in accordance with the Inadvertent Discovery Plan in the event of an inadvertent discovery of a cultural resource during NBA ground-disturbing activities.
	State Executive Order 21-02	Consultation with DAHP and any affected tribes and implementation of measures to avoid, minimize, or mitigate adverse effects to archeological and historic archaeological sites, historic buildings/structures, traditional cultural places, sacred sites or other cultural resources are required for state-funded construction or acquisition projects.		✓		Yes	
	Federal Archaeological and Historic Preservation Act (54 USC 312501 et seq., 43 CFR 7)	Requirements exist to evaluate and preserve historical and archaeological data.		✓		Yes	
	Tacoma Landmarks and Historic Districts (Chapter 13.07 TMC)	Requirements exist to protect, enhance, and use landmarks, districts, and elements of historic, cultural, architectural, archeological, engineering, and geographic significance located within the City of Tacoma.		✓		Yes	

Table B-1: Preliminary Evaluation of Potentially Applicable or Relevant and Appropriate Requirements (ARARs) for Cleanup Action Implementation

Type	Law/Regulation/Requirement	Brief Synopsis of Law/Regulation/Requirement	Chemical	Location	Action	ARAR?	Comment for Cleanup Action Implementation
Water and Shorelines	Federal Clean Water Act (33 USC 1251 et seq., 40 CFR 122-136)	Requirements (e.g., obtaining a NPDES permit) exist for wastewater and stormwater discharges to avoid adversely affecting water quality.	✓		✓	Yes	Management of water generated during any dewatering activities will be further assessed during remedial design. In general, water generated from dewatering would be (1) containerized and disposed of at an off-site facility permitted to receive the waste, (2) treated and re-used in accordance with an applicable permit, and/or (3) discharged to a sanitary or stormwater sewer in accordance with an applicable permit. Best management practices will be implemented during cleanup action implementation to minimize erosion and address potential adverse affects from construction stormwater. Coverage under a general construction stormwater NPDES permit will be obtained as necessary prior to cleanup action implementation.
Water and Shorelines	State NPDES Permit Program (Chapter 90.48 RCW, Chapter 173-220 WAC)	A state program exists to regulate the discharge of pollutants, wastes, and materials to surface waters of the state via Clean Water Act NPDES permits.	✓		✓	Yes	Management of water generated during any dewatering activities will be further assessed during remedial design. In general, water generated from dewatering would be (1) containerized and disposed of at an off-site facility permitted to receive the waste, (2) treated and re-used in accordance with an applicable permit, and/or (3) discharged to a sanitary or stormwater sewer in accordance with an applicable permit. Best management practices will be implemented during cleanup action implementation to minimize erosion and address potential adverse affects from construction stormwater. Coverage under a general construction stormwater NPDES permit will be obtained as necessary prior to cleanup action implementation.
Water and Shorelines	State Waste Discharge Permit Program (Chapter 90.48 RCW, WAC 173-216)	A state program exists to regulate the discharge of waste materials from industrial, commercial, and municipal operations into municipal sewerage systems and waters of the state via non-NPDES individual permits.	✓		✓	Yes	Management of water generated during any dewatering activities will be further assessed during remedial design. In general, water generated from dewatering would be (1) containerized and disposed of at an off-site facility permitted to receive the waste, (2) treated and re-used in accordance with an applicable permit, and/or (3) discharged to a sanitary or stormwater sewer in accordance with an applicable permit. Best management practices will be implemented during cleanup action implementation to minimize erosion and address potential adverse affects from construction stormwater. Coverage under a general construction stormwater NPDES permit will be obtained as necessary prior to cleanup action implementation.
Water and Shorelines	State Waste Discharge General Permit Program (Chapter 90.48 RCW, Chapter 173-226 WAC)	A state program exists to regulate the discharge of pollutants, wastes, and other materials to municipal sewerage systems and waters of the state via non-NPDES general permits.	✓		✓	Yes	Management of water generated during any dewatering activities will be further assessed during remedial design. In general, water generated from dewatering would be (1) containerized and disposed of at an off-site facility permitted to receive the waste, (2) treated and re-used in accordance with an applicable permit, and/or (3) discharged to a sanitary or stormwater sewer in accordance with an applicable permit. Best management practices will be implemented during cleanup action implementation to minimize erosion and address potential adverse affects from construction stormwater. Coverage under a general construction stormwater NPDES permit will be obtained as necessary prior to cleanup action implementation.
Water and Shorelines	Tacoma Wastewater and Surface Water Management (Chapter 12.08 TMC)	Requirements exist for users of the publicly owned treatment works and the storm drainage system of the City of Tacoma.	✓		✓	Yes	Management of water generated during any dewatering activities will be further assessed during remedial design. In general, water generated from dewatering would be (1) containerized and disposed of at an off-site facility permitted to receive the waste, (2) treated and re-used in accordance with an applicable permit, and/or (3) discharged to a sanitary or stormwater sewer in accordance with an applicable permit. Best management practices will be implemented during cleanup action implementation to minimize erosion and address potential adverse affects from construction stormwater. Coverage under a general construction stormwater NPDES permit will be obtained as necessary prior to cleanup action implementation.
Water and Shorelines	Federal Clean Water Act Permits for Dredge or Fill Materials (33 USC 1344, 33 CFR 323)	Unless exempted, the discharge of dredge or fill material into waters of the United States, including wetlands, requires a permit.		✓	✓	No	This is not an ARAR since implementation of remedial components in the cleanup action alternatives would not result in the discharge of dredge or fill material into a water of the United States.
Water and Shorelines	Federal Floodplain Management (Executive Order 11988)	Federal agencies shall take actions in order to avoid, to the extent possible, the adverse effects associated with modifications of floodplains and direct or indirect support of floodplain development whenever there is a practicable alternative.		✓	✓	No	These are not ARARs since none of the remedial components in the cleanup action alternatives would be located within a Federal Emergency Management Agency 100-year or 500-year flood zone, and no jurisdictional wetlands are present where the cleanup action alternatives would be implemented.
Water and Shorelines	State Floodplain Management (Chapter 86.16 RCW, Chapter 173-158 WAC)	Establishes standards to be administered by local governments, and provides assistance to local governments. In addition, local governments are encouraged to avoid the adverse impacts associated with the destruction or modification of wetlands.		✓	✓	No	These are not ARARs since none of the remedial components in the cleanup action alternatives would be located within a Federal Emergency Management Agency 100-year or 500-year flood zone, and no jurisdictional wetlands are present where the cleanup action alternatives would be implemented.
Water and Shorelines	Federal Protection of Wetlands (Executive Order 11990)	Federal agencies shall take actions in order to avoid, to the extent possible, the adverse effects associated with modifications of wetlands and direct or indirect support of new construction in wetlands whenever there is a practicable alternative.		✓	✓	No	These are not ARARs since none of the remedial components in the cleanup action alternatives would be located within a Federal Emergency Management Agency 100-year or 500-year flood zone, and no jurisdictional wetlands are present where the cleanup action alternatives would be implemented.
Water and Shorelines	Tacoma Critical Areas Preservation for Flood Hazard Areas and Wetlands (Chapters 13.11.300-13.11.360, 13.11.600-13.11.640 TMC)	Regulations exist to classify, protect, and preserve Tacoma's flood hazard areas and wetlands. Other critical areas (i.e., stream corridors, fish and wildlife habitat conservation areas, geologically hazardous areas, and critical aquifer recharge areas) were evaluated as a separate requirement.		✓	✓	No	These are not ARARs since none of the remedial components in the cleanup action alternatives would be located within a Federal Emergency Management Agency 100-year or 500-year flood zone, and no jurisdictional wetlands are present where the cleanup action alternatives would be implemented.
Water and Shorelines	State Shoreline Management Act (Chapter 90.58 RCW; Chapter 173-26 WAC)	Requirements exist for substantial development occurring within 200 feet of a state shoreline to prevent harm from uncoordinated and piecemeal development of shorelines.		✓	✓	Yes	Since all four cleanup action alternatives include excavation and/or filling within 200 feet of the shoreline, these requirements will be further evaluated during remedial design and any applicable permits will be obtained prior to cleanup action implementation.
Water and Shorelines	Tacoma Shoreline Master Program (Chapter 19 TMC)	Implements the state Shoreline Management Act by providing goals, policies, and regulations for shoreline use and protection, and establishing a permit system for substantial development occurring within 200 feet of a City of Tacoma shoreline. Specific requirements for the Port Industrial Area are included in TMC 19.12.		✓	✓	Yes	Since all four cleanup action alternatives include excavation and/or filling within 200 feet of the shoreline, these requirements will be further evaluated during remedial design and any applicable permits will be obtained prior to cleanup action implementation.
Water and Shorelines	State Well Construction Standards (Chapter 18.104 RCW, Chapter 173-160 WAC)	Establishes standards for construction, maintenance, and decommissioning of water supply wells and resource protection wells (e.g., monitoring wells).			✓	Yes	Monitoring wells associated with cleanup action implementation will be constructed, maintained, and decommissioned in accordance with Chapter 173-160 WAC.
Water and Shorelines	Federal Drinking Water Standards (Safe Drinking Water Act, 40 CFR 141)	Establishes maximum contaminant levels and other chemical standards for public drinking water systems.	✓			No	These are not ARARs because no current drinking water supplies are located in or downgradient of the NBA, groundwater in and downgradient of the NBA is not potable, and surface water downgradient of the NBA is not potable.
Water and Shorelines	State Drinking Water Standards (RCW 70A.125, WAC 246-290-310)	Establishes maximum contaminant levels and other chemical standards for public drinking water systems.	✓			No	These are not ARARs because no current drinking water supplies are located in or downgradient of the NBA, groundwater in and downgradient of the NBA is not potable, and surface water downgradient of the NBA is not potable.
Water and Shorelines	State Water Quality Standards for Groundwater (Chapters 90.48 RCW, Chapter 90.54 RCW, Chapter 173-200 WAC)	Establishes groundwater quality standards to provide for protection of existing and future use of groundwater.	✓		✓	No	This is not an ARAR since cleanup actions approved by Ecology under MTCA are exempt pursuant to WAC 173-200-010(3)(c).

Table B-1: Preliminary Evaluation of Potentially Applicable or Relevant and Appropriate Requirements (ARARs) for Cleanup Action Implementation

Type	Law/Regulation/Requirement	Brief Synopsis of Law/Regulation/Requirement	Chemical	Location	Action	ARAR?	Comment for Cleanup Action Implementation
Air	Federal Clean Air Act (42 USC 7401 et seq., 40 CFR 50)	Air emissions from stationary and mobile sources are regulated by directing states to develop state implementation plans to achieve National Ambient Air Quality Standards.	✓		✓	No	These are not ARARs since none of the cleanup action alternatives include regulated air emissions.
	State General Regulations for Air Pollution Sources (Chapter 70A.15 RCW, Chapter 173-400 WAC)	Establishes standards and rules generally applicable to the control and/or prevention of the emission of air contaminants from stationary sources. Dust control requirements were evaluated as a separate requirement.	✓		✓	No	
	State Controls for New Sources of Toxic Air Pollutants (Chapter 70A.15 RCW, Chapter 173-460 WAC)	Establishes controls for new or modified sources emitting toxic air pollutants by requiring best available control technologies, toxic air pollutant emission quantifications, and human health and safety protection demonstrations.	✓		✓	No	
	State Ambient Air Quality Standards (Chapter 70A.15 RCW, Chapter 173-476 WAC)	Adopts National Ambient Air Quality Standards for particulate matter, lead, sulfur dioxide, nitrogen dioxide, ozone, and carbon monoxide.	✓		✓	No	
	PSCAA Regulation I	Establishes regulations to control the emission of air contaminants from sources (e.g., new sources, outdoor burning, solid fuel burning) in Pierce, King, Snohomish, and Kitsap Counties. Dust control requirements were evaluated as a separate requirement.	✓		✓	No	
	PSCAA Regulation III	Adopts state and federal requirements for regulation of toxic air contaminants in in Pierce, King, Snohomish, and Kitsap Counties.	✓		✓	No	
	Dust control requirements (WAC 173-400-040(9). PSCAA Regulation I Article 9.15)	Requirements exist to implement reasonable precautions to prevent or minimize visible emissions of fugitive dust during activities such as construction.			✓	Yes	Dust control measures (e.g., watering/misting exposed surfaces, covering stockpiles not in use with heavy duty plastic sheeting and securing with ropes and sandbags, covering haul trucks, inspecting haul trucks before they enter public roads and removing any excess dirt on the truck) will be incorporated as necessary into cleanup action implementation.
Other	State Environmental Policy Act (Chapter 43.21C RCW, Chapter 197-11 WAC)	Requires all government agencies to consider and assess the environmental impacts of a proposed action within the state before making a decision. The SEPA procedural requirements are fulfilled via the MTCA remedy selection process pursuant to WAC 197-11-250 through 197-11-268.			✓	Yes	A SEPA checklist will be submitted to Ecology (the lead agency) during the FS phase or draft CAP phase to help Ecology decide whether or not an environmental impact statement needs to be prepared for the selected cleanup action alternative.
	Tacoma Site Development Code (Chapter 2.19 TMC)	Requirements (e.g., obtaining a Site Development Permit) exist for the development and maintenance of building and building sites to minimize negative impacts to the environment.			✓	Yes	Prior to cleanup action implementation, a Site Development Permit will be obtained for upland gradient activities associated with cleanup action implementation. Although it is highly unlikely that any critical areas would be affected by cleanup action implementation, critical areas will be further evaluated during remedial design.
	Tacoma Critical Area Preservation (Chapter 13.11 TMC)	Establishes requirements to classify, protect, and preserve Tacoma's critical areas (e.g., stream corridors, fish and wildlife habitat conservation areas, geologically hazardous areas, and critical aquifer recharge areas). Flood hazard areas and wetlands were evaluated as a separate requirement.		✓	✓	Yes	
	State Noise Control Act (Chapter 70A.20 RCW, Chapter 173-60 WAC)	Establishes maximum noise levels at specified times for specified durations, with some exemptions such as temporary construction activity in 173-60-050(3)(a).			✓	Yes	Cleanup action implementation activities will be designed to comply with applicable noise requirements (e.g., limiting construction activities to the working hours specified in TMC 8.12.070).
	Tacoma Noise Enforcement (Chapter 8.122 TMC)	Requirements exist to mitigate the adverse impact of noise while recognizing the economic value of construction and industry. Construction-specific requirements are included in TMC 8.122.070.			✓	Yes	
	Tacoma Right-of-Way Development (Chapter 2.22 TMC)	Requirements (e.g., obtaining a Right-of-Way Construction Permit or Right-of-Way Use Permit) exist for activities such as installing sidewalks, installing utilities, installing driveways, repairing streets, and activities that temporarily impede the normal flow of vehicular traffic or pedestrian traffic.		✓	✓	No	This is not an ARAR since none of the cleanup action alternatives include construction within, or cause temporary impediment for, a City of Tacoma right-of-way.
	Tacoma Electrical Code (Chapter 12.06A TMC)	Requirements (e.g., obtaining an electrical permit) exist to safeguard people and property from electrical hazards arising from the use of electricity, including temporary power connections and wiring used for remediation systems.			✓	No	This is not an ARAR since none of the of the cleanup action alternatives include temporary power connections or wiring for remediation systems.

Notes:

ARAR: Applicable or relevant and appropriate; CFR: Code of Federal Regulations; DAHP: Department of Archaeology and Historic Preservation; MTCA: Model Toxics Control Act; NPDES: National Pollutant Discharge Elimination System; PSCAA: Puget Sound Clean Air Agency; RCW: Revised Code of Washington; SEPA: State Environmental Policy Act; TMC: Tacoma Municipal Code; USC: United States Code; WAC: Washington Administrative Code

Appendix C

PIONEER TECHNOLOGIES CORPORATION

Table C-1: Preliminary Cost Estimate for Alternative 1 (Cap/Cover, MNA, and ICs)

Category	Item Description	Qty	Unit	Basis for Quantity Assumption	Unit Cost	Basis for Unit Cost Assumption	Cost
Direct Capital Construction Costs	Miscellaneous Contractor-prepared plans and permits	1	LS	Qty assumed to simplify estimate.	$30,000	Assumed based on similar items at other sites.	$30,000
	Protect/modify/decommission MWs based on construction areas/activities	1	LS	Qty assumed to simplify estimate.	$10,000	Assumed based on similar items at other sites.	$10,000
	Contractor mobilization and de-mobilization	5	%	Assumed % of the following direct capital construction costs (excluding contingency).	N/A	N/A	$17,800
	Site prep and miscellaneous requirements (1)	1	LS	Qty assumed to simplify estimate.	$50,000	Assumed based on anticipated level of effort.	$50,000
	Purchase and install geotextile marker layer under soil cover	120,000	SF	Assumed 120,000 SF to receive soil cover (see Figure 5-1).	$0.5	Assumed based on similar items at other sites.	$60,000
	Gravel borrow, haul, placement, and compaction for soil cover	6,600	Ton	Assumed 4,400 CY to create one-foot thick gravel cover, and density of 1.5 tons/CY.	$35	Assumed based on similar items at other sites.	$231,000
	Install performance MWs for long-term GWM	1	LS	Qty assumed to simplify estimate.	$15,000	Assumed based on similar items at other sites.	$15,000
	Contingency (e.g., for larger quantities and/or unit costs)	25	%	Assumed % of the above direct capital construction costs.	N/A	N/A	$103,450
						Subtotal (2)	$520,000
Indirect Capital Construction Costs	Pre-design investigation work plan, field, lab, and reporting	1	LS	Qty assumed to simplify estimate.	$100,000	Assumed based on anticipated level of effort.	$100,000
	Remedial design and procurement/permitting/ARAR compliance support	1	LS	Qty assumed to simplify estimate.	$100,000	Assumed based on anticipated level of effort.	$100,000
	Permit fees (e.g., grading permit)	1	LS	Qty assumed to simplify estimate.	$25,000	Assumed based on similar items at other sites.	$25,000
	Construction field oversight	8	%	Assumed % of direct capital construction costs.	N/A	N/A	$41,600
	Sampling and analysis costs during construction	2	%	Assumed % of direct capital construction costs.	N/A	N/A	$10,400
	Construction completion report	4	%	Assumed % of direct capital construction costs.	N/A	N/A	$20,800
	Develop and record restrictive covenant	1	LS	Qty assumed to simplify estimate.	$10,000	Assumed based on anticipated level of effort.	$10,000
	Consultant project management	4	%	Assumed % of direct capital construction costs.	N/A	N/A	$20,800
	Port oversight costs	8	%	Assumed % of direct capital construction costs.	N/A	N/A	$41,600
	Ecology oversight costs	4	%	Assumed % of direct capital construction costs.	N/A	N/A	$20,800
						Subtotal (2)	$390,000
Annual or Periodic Costs	Cap/cover inspections (Years 1 - 100)	100	Each	Assumed annual inspections.	$5,000	Assumed based on anticipated level of effort and 2020 Port correspondence regarding similar items at other Port sites.	$500,000
	Cover and fence maintenance prior to redevelopment (Years 1 - 5)	5	Each	Assumed annual maintenance of cover and fence.	$10,000		$50,000
	Modify cover as necessary to facilitate redevelopment	1	LS	Qty assumed to simplify estimate, with modification assumed to occur in Year 5.	$200,000		$200,000
	Cap and fence maintenance after redevelopment (Years 6 - 100)	95	Each	Assumed annual maintenance of cap (e.g., filling cracks) and fence.	$50,000		$4,750,000
	GWM field, lab, and reporting (Years 1 - 10)	10	Each	Assumed annual GWM events.	$20,000		$200,000
	GWM field, lab, and reporting (Years 11 - 100)	36	Each	Assumed a GWM event every 2.5 years.	$20,000		$720,000
	MNA evaluations and five year review reports	20	Each	Assumed to occur every 5 years.	$10,000		$200,000
	IC inspections (Years 1 - 100)	100	Each	Assumed annual inspections.	$2,000		$200,000
						Subtotal (2)	$6,820,000
						Total (2)	**$7,730,000**

Notes:

ARAR: Applicable or relevant and appropriate requirement; CY: cubic yards; GWM: groundwater monitoring; LB: pound; LS: lump sum, N/A: not applicable; Qty: quantity; SF: square feet

This cost estimate was prepared solely to facilitate relative comparisons between alternatives for the purposes of this Report, and is intended to be -30% to +50%. Since this ballpark estimate is based on a variety of simplifying assumptions and PIONEER has no control over the pre-design investigation results, the remedial design, Port requirements, the cost of labor, materials, and equipment, or the nature of a particular competitive bidding process at the time the work would be performed, the estimated costs should not be construed to equal actual implementation costs. It is expected that implementation cost estimates will be refined during remedial design, and then following procurement.

The duration of this alternative was assumed to be 100 years because net present value costs beyond 100 years are insignificant relative to the overall costs.

This cost estimate does not include any costs for redevelopment (e.g., installing utilities, installing a paved working surface cap, installing stormwater treatment).

(1) This item includes costs related to health and safety implementation, site control, clearing and grubbing, creating containment areas for stockpiles, stockpile management, dust control, stormwater control, hydroseeding, etc.

(2) Rounded to the nearest $10,000.

Table C-2: Net Present Value for Alternative 1 (Cap/Cover, MNA, and ICs)

Year	Cost Type	Total Cost	Discount Factor (1)	Net Present Value
0	Direct and indirect capital construction costs (2)	$910,000	1.000	$910,000
1	Annual or periodic costs	$37,000	0.976	$36,098
2	Annual or periodic costs	$37,000	0.952	$35,217
3	Annual or periodic costs	$37,000	0.929	$34,358
4	Annual or periodic costs	$37,000	0.906	$33,520
5	Annual or periodic costs	$247,000	0.884	$218,312
6	Annual or periodic costs	$77,000	0.862	$66,397
7	Annual or periodic costs	$77,000	0.841	$64,777
8	Annual or periodic costs	$77,000	0.821	$63,197
9	Annual or periodic costs	$77,000	0.801	$61,656
10	Annual or periodic costs	$87,000	0.781	$67,964
11	Annual or periodic costs	$57,000	0.762	$43,442
12	Annual or periodic costs	$57,000	0.744	$42,383
13	Annual or periodic costs	$77,000	0.725	$55,857
14	Annual or periodic costs	$57,000	0.708	$40,340
15	Annual or periodic costs	$87,000	0.690	$60,071
16	Annual or periodic costs	$57,000	0.674	$38,397
17	Annual or periodic costs	$57,000	0.657	$37,460
18	Annual or periodic costs	$77,000	0.641	$49,370
19	Annual or periodic costs	$57,000	0.626	$35,655
20	Annual or periodic costs	$87,000	0.610	$53,094
21	Annual or periodic costs	$57,000	0.595	$33,937
22	Annual or periodic costs	$57,000	0.581	$33,109
23	Annual or periodic costs	$77,000	0.567	$43,636
24	Annual or periodic costs	$57,000	0.553	$31,514
25	Annual or periodic costs	$87,000	0.539	$46,927
26	Annual or periodic costs	$57,000	0.526	$29,995
27	Annual or periodic costs	$57,000	0.513	$29,264
28	Annual or periodic costs	$77,000	0.501	$38,568
29	Annual or periodic costs	$57,000	0.489	$27,854
30	Annual or periodic costs	$87,000	0.477	$41,477
31	Annual or periodic costs	$57,000	0.465	$26,512
32	Annual or periodic costs	$57,000	0.454	$25,865
33	Annual or periodic costs	$77,000	0.443	$34,088
34	Annual or periodic costs	$57,000	0.432	$24,619
35	Annual or periodic costs	$87,000	0.421	$36,659
36	Annual or periodic costs	$57,000	0.411	$23,432
37	Annual or periodic costs	$57,000	0.401	$22,861
38	Annual or periodic costs	$77,000	0.391	$30,129
39	Annual or periodic costs	$57,000	0.382	$21,759
40	Annual or periodic costs	$87,000	0.372	$32,401
41	Annual or periodic costs	$57,000	0.363	$20,711

Table C-2: Net Present Value for Alternative 1 (Cap/Cover, MNA, and ICs)

Year	Cost Type	Total Cost	Discount Factor (1)	Net Present Value
42	Annual or periodic costs	$57,000	0.354	$20,206
43	Annual or periodic costs	$77,000	0.346	$26,630
44	Annual or periodic costs	$57,000	0.337	$19,232
45	Annual or periodic costs	$87,000	0.329	$28,638
46	Annual or periodic costs	$57,000	0.321	$18,305
47	Annual or periodic costs	$57,000	0.313	$17,859
48	Annual or periodic costs	$77,000	0.306	$23,537
49	Annual or periodic costs	$57,000	0.298	$16,998
50	Annual or periodic costs	$87,000	0.291	$25,312
51	Annual or periodic costs	$57,000	0.284	$16,179
52	Annual or periodic costs	$57,000	0.277	$15,785
53	Annual or periodic costs	$77,000	0.270	$20,803
54	Annual or periodic costs	$57,000	0.264	$15,024
55	Annual or periodic costs	$87,000	0.257	$22,372
56	Annual or periodic costs	$57,000	0.251	$14,300
57	Annual or periodic costs	$57,000	0.245	$13,951
58	Annual or periodic costs	$77,000	0.239	$18,387
59	Annual or periodic costs	$57,000	0.233	$13,279
60	Annual or periodic costs	$87,000	0.227	$19,774
61	Annual or periodic costs	$57,000	0.222	$12,639
62	Annual or periodic costs	$57,000	0.216	$12,331
63	Annual or periodic costs	$77,000	0.211	$16,251
64	Annual or periodic costs	$57,000	0.206	$11,737
65	Annual or periodic costs	$87,000	0.201	$17,477
66	Annual or periodic costs	$57,000	0.196	$11,171
67	Annual or periodic costs	$57,000	0.191	$10,899
68	Annual or periodic costs	$77,000	0.187	$14,364
69	Annual or periodic costs	$57,000	0.182	$10,374
70	Annual or periodic costs	$87,000	0.178	$15,447
71	Annual or periodic costs	$57,000	0.173	$9,874
72	Annual or periodic costs	$57,000	0.169	$9,633
73	Annual or periodic costs	$77,000	0.165	$12,695
74	Annual or periodic costs	$57,000	0.161	$9,169
75	Annual or periodic costs	$87,000	0.157	$13,653
76	Annual or periodic costs	$57,000	0.153	$8,727
77	Annual or periodic costs	$57,000	0.149	$8,514
78	Annual or periodic costs	$77,000	0.146	$11,221
79	Annual or periodic costs	$57,000	0.142	$8,104
80	Annual or periodic costs	$87,000	0.139	$12,067
81	Annual or periodic costs	$57,000	0.135	$7,713
82	Annual or periodic costs	$57,000	0.132	$7,525
83	Annual or periodic costs	$77,000	0.129	$9,918
84	Annual or periodic costs	$57,000	0.126	$7,163

Table C-2: Net Present Value for Alternative 1 (Cap/Cover, MNA, and ICs)

Year	Cost Type	Total Cost	Discount Factor (1)	Net Present Value
85	Annual or periodic costs	$87,000	0.123	$10,666
86	Annual or periodic costs	$57,000	0.120	$6,817
87	Annual or periodic costs	$57,000	0.117	$6,651
88	Annual or periodic costs	$77,000	0.114	$8,766
89	Annual or periodic costs	$57,000	0.111	$6,331
90	Annual or periodic costs	$87,000	0.108	$9,427
91	Annual or periodic costs	$57,000	0.106	$6,026
92	Annual or periodic costs	$57,000	0.103	$5,879
93	Annual or periodic costs	$77,000	0.101	$7,748
94	Annual or periodic costs	$57,000	0.098	$5,595
95	Annual or periodic costs	$87,000	0.096	$8,332
96	Annual or periodic costs	$57,000	0.093	$5,326
97	Annual or periodic costs	$57,000	0.091	$5,196
98	Annual or periodic costs	$77,000	0.089	$6,848
99	Annual or periodic costs	$57,000	0.087	$4,946
100	Annual or periodic costs	$87,000	0.085	$7,364
			Total Net Present Value of Alternative (3)	**$3,500,000**

Notes:

See Table C-1 for the cost estimate details associated with this alternative. Inflation and depreciation are not included in this estimate.

(1) The net present value was calculated assuming an annual 2.5% discount rate based on input from the Port.

(2) For simplicity, all construction costs were assumed to occur in the base year.

(3) Rounded to nearest $100,000.

Table C-3: Preliminary Cost Estimate for Alternative 2 (Excavate RLs, Cap/Cover, MNA, and ICs)

Category	Item Description	Qty	Unit	Basis for Quantity Assumption	Unit Cost	Basis for Unit Cost Assumption	Cost
Direct Capital Construction Costs	Miscellaneous Contractor-prepared plans and permits	1	LS	Qty assumed to simplify estimate.	$30,000	Assumed based on similar items at other sites.	$30,000
	Protect/modify/decommission MWs based on construction areas/activities	1	LS	Qty assumed to simplify estimate.	$10,000	Assumed based on similar items at other sites.	$10,000
	Contractor mobilization and de-mobilization	5	%	Assumed % of the following direct capital construction costs (excluding contingency).	N/A	N/A	$120,392
	Site prep and miscellaneous requirements [1]	1	LS	Qty assumed to simplify estimate.	$50,000	Assumed based on anticipated level of effort.	$50,000
	Excavate and stockpile 0-5 feet bgs overburden soil	4,650	Ton	Assumed 3,100 CY to access 5-10 feet bgs soil (see Figure 5-2) and soil density of 1.5 tons/CY.	$35	Assumed based on similar items at other sites.	$162,750
	Excavate and stockpile soil for off-site disposal	5,400	Ton	Assumed 3,600 CY to excavate exceedances (see Figure 5-2) and soil density of 1.5 ton/CY.	$35	Assumed based on similar items at other sites.	$189,000
	Dewatering, treatment, and disposal	1	LS	Qty assumed to simplify estimate.	$200,000	Assumed based on similar items at other sites.	$200,000
	Ex-situ stabilization to minimize hazardous waste Qty	2,700	Ton	Assumed 50% of soil would be non-hazardous as is, 50% of soil would be treated, 90% of soil being treated would be successfully stabilized during first treatment, and no further treatment would be conducted.	$200	Assumed $165/ton for materials based on Arkema Property bench test dosing and 2019 correspondence with Premier Magnesia and Carus Corporation, and $35/ton for treatment operations.	$540,000
	Dry, load, haul, and dispose of excavated material that is non-hazardous waste at the LRI facility in Graham, Washington	5,130	Ton	Assumed Qty based on assumptions in two previous rows.	$70	Assumed $20/ton for drying/loading, $15/ton for haul, and $35/ton for disposal per 2019 LRI correspondence.	$359,100
	Dry, load, haul, treat, and dispose of excavated soil that is hazardous waste at the Waste Management facility in Arlington, Oregon	270	Ton	Assumed Qty based on assumed percentage of soil that was not successfully stabilized.	$687	Assumed $20/ton for drying/loading, and $667/ton for haul, treat, and disposal per 2019 Waste Management correspondence.	$185,490
	Zero valent iron material and delivery cost for backfill	90	Ton	Assumed 10% zero valent iron for one foot backfill layer and density of 1.5 tons/CY.	$2,000	Assumed based on similar items at other sites.	$180,000
	Backfill using overburden soil	4,650	Ton	Assumed Qty equals the Qty from excavation and stockpile overburden soil.	$10	Assumed based on similar items at other sites.	$46,500
	Gravel borrow, haul, and backfill soil excavations	5,400	Ton	Assumed Qty equals the Qty from excavate and stockpile soil with exceedances.	$35	Assumed based on similar items at other sites.	$189,000
	Purchase and install geotextile marker layer under soil cover	120,000	SF	Assumed 120,000 SF to receive soil cover (see Figure 5-2).	$0.5	Assumed based on similar items at other sites.	$60,000
	Gravel borrow, haul, placement, and compaction for soil cover	6,600	Ton	Assumed 4,400 CY to create one-foot thick gravel cover, and density of 1.5 tons/CY.	$35	Assumed based on similar items at other sites.	$231,000
	Install performance MWs for long-term GWM	1	LS	Qty assumed to simplify estimate.	$15,000	Assumed based on similar items at other sites.	$15,000
	Contingency (e.g., for larger quantities and/or unit costs)	25	%	Assumed % of the above direct capital construction costs.	N/A	N/A	$642,058
						Subtotal [2]	$3,210,000
Indirect Capital Construction Costs	Pre-design investigation work plan, field, lab, and reporting	1	LS	Qty assumed to simplify estimate.	$100,000	Assumed based on anticipated level of effort.	$100,000
	Remedial design and procurement/permitting/ARAR compliance support	1	LS	Qty assumed to simplify estimate.	$100,000	Assumed based on anticipated level of effort.	$100,000
	Permit fees (e.g., grading permit)	1	LS	Qty assumed to simplify estimate.	$25,000	Assumed based on similar items at other sites.	$25,000
	Construction field oversight	1.5	%	Assumed % of direct capital construction costs.	N/A	N/A	$48,150
	Sampling and analysis costs during construction	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$32,100
	Construction completion report	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$32,100
	Develop and record restrictive covenant	1	LS	Qty assumed to simplify estimate.	$10,000	Assumed based on anticipated level of effort.	$10,000
	Consultant project management	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$32,100
	Port oversight costs	1.5	%	Assumed % of direct capital construction costs.	N/A	N/A	$48,150
	Ecology oversight costs	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$32,100
						Subtotal [2]	$460,000
Annual or Periodic Costs	Cap/cover inspections (Years 1 - 100)	100	Each	Assumed annual inspections.	$5,000	Assumed based on anticipated level of effort and 2020 Port correspondence regarding similar items at other Port sites.	$500,000
	Cover and fence maintenance prior to redevelopment (Years 1 - 5)	5	Each	Assumed annual maintenance of cover and fence.	$10,000		$50,000
	Modify cover as necessary to facilitate redevelopment	1	LS	Qty assumed to simplify estimate, with modification assumed to occur in Year 5.	$200,000		$200,000
	Cap and fence maintenance after redevelopment (Years 6 - 100)	95	Each	Assumed annual maintenance of cap (e.g., filling cracks) and fence.	$50,000		$4,750,000
	GWM field, lab, and reporting (Years 1 - 10)	10	Each	Assumed annual GWM events.	$20,000		$200,000
	GWM field, lab, and reporting (Years 11 - 100)	36	Each	Assumed a GWM event every 2.5 years.	$20,000		$720,000
	MNA evaluations and five year review reports	20	Each	Assumed to occur every 5 years.	$10,000		$200,000
	IC inspections (Years 1 - 100)	100	Each	Assumed annual inspections.	$2,000		$200,000
						Subtotal [2]	$6,820,000
						Total [2]	**$10,490,000**

Notes:

ARAR: Applicable or relevant and appropriate requirement; CY: cubic yards; GWM: groundwater monitoring; LB: pound; LS: lump sum, N/A: not applicable; Qty: quantity; SF: square feet

This cost estimate was prepared solely to facilitate relative comparisons between alternatives for the purposes of this Report, and is intended to be -30% to +50%. Since this ballpark estimate is based on a variety of simplifying assumptions and PIONEER has no control over the pre-design investigation results, the remedial design, Port requirements, the cost of labor, materials, and equipment, or the nature of a particular competitive bidding process at the time the work would be performed, the estimated costs should not be construed to equal actual implementation costs. It is expected that implementation cost estimates will be refined during remedial design, and then following procurement.

The duration of this alternative was assumed to be 100 years because the cap/cover would exist for perpetuity and there is uncertainty in the estimated groundwater restoration time frame for this alternative. Net present value costs beyond 100 years are insignificant relative to the overall costs.

This cost estimate does not include any costs for redevelopment (e.g., installing utilities, installing a paved working surface cap, installing stormwater treatment).

[1] This item includes costs related to health and safety implementation, site control, clearing and grubbing, creating containment areas for stockpiles, stockpile management, dust control, stormwater control, hydroseeding, etc.

[2] Rounded to the nearest $10,000.

Table C-4: Net Present Value for Alternative 2 (Excavate RLs, Cap/Cover, MNA, and ICs)

Year	Cost Type	Total Cost	Discount Factor (1)	Net Present Value
0	Direct and indirect capital construction costs (2)	$3,670,000	1.000	$3,670,000
1	Annual or periodic costs	$37,000	0.976	$36,098
2	Annual or periodic costs	$37,000	0.952	$35,217
3	Annual or periodic costs	$37,000	0.929	$34,358
4	Annual or periodic costs	$37,000	0.906	$33,520
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18	Annual or periodic costs	$77,000	0.641	$49,370
19	Annual or periodic costs	$57,000	0.626	$35,655
20	Annual or periodic costs	$87,000	0.610	$53,094
21	Annual or periodic costs	$57,000	0.595	$33,937
22	Annual or periodic costs	$57,000	0.581	$33,109
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25	Annual or periodic costs	$87,000	0.539	$46,927
26	Annual or periodic costs	$57,000	0.526	$29,995
27	Annual or periodic costs	$57,000	0.513	$29,264
28	Annual or periodic costs	$77,000	0.501	$38,568
29	Annual or periodic costs	$57,000	0.489	$27,854
30	Annual or periodic costs	$87,000	0.477	$41,477
31	Annual or periodic costs	$57,000	0.465	$26,512
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89	Annual or periodic costs	$57,000	0.111	$6,331
90	Annual or periodic costs	$87,000	0.108	$9,427
91	Annual or periodic costs	$57,000	0.106	$6,026
92	Annual or periodic costs	$57,000	0.103	$5,879
93	Annual or periodic costs	$77,000	0.101	$7,748
94	Annual or periodic costs	$57,000	0.098	$5,595
95	Annual or periodic costs	$87,000	0.096	$8,332
96	Annual or periodic costs	$57,000	0.093	$5,326
97	Annual or periodic costs	$57,000	0.091	$5,196
98	Annual or periodic costs	$77,000	0.089	$6,848
99	Annual or periodic costs	$57,000	0.087	$4,946
100	Annual or periodic costs	$87,000	0.085	$7,364
Total Net Present Value of Alternative (3)				**$6,200,000**

Notes:

See Table C-3 for the cost estimate details associated with this alternative. Inflation and depreciation are not included in this estimate.

(1) The net present value was calculated assuming an annual 2.5% discount rate based on input from the Port.

(2) For simplicity, all construction costs were assumed to occur in the base year.

(3) Rounded to nearest $100,000.

PIONEER TECHNOLOGIES CORPORATION

Table C-5: Preliminary Cost Estimate for Alternative 3 (Excavate Industrial CLs, MNA, and ICs)

Category	Item Description	Qty	Unit	Basis for Quantity Assumption	Unit Cost	Basis for Unit Cost Assumption	Cost
Direct Capital Construction Costs	Miscellaneous Contractor-prepared plans and permits	1	LS	Qty assumed to simplify estimate.	$30,000	Assumed based on similar items at other sites.	$30,000
	Protect/modify/decommission MWs based on construction areas/activities	1	LS	Qty assumed to simplify estimate.	$10,000	Assumed based on similar items at other sites.	$10,000
	Contractor mobilization and de-mobilization	5	%	Assumed % of the following direct capital construction costs (excluding contingency).	N/A	N/A	$229,428
	Site prep and miscellaneous requirements (1)	1	LS	Qty assumed to simplify estimate.	$50,000	Assumed based on anticipated level of effort.	$50,000
	Excavate and stockpile 0-5 feet bgs overburden soil	5,850	Ton	Assumed 3,900 CY to access 5-10 feet bgs soil (see Figure 5-3) and soil density of 1.5 tons/CY.	$35	Assumed based on similar items at other sites.	$204,750
	Excavate and stockpile soil for off-site disposal	19,500	Ton	Assumed 13,000 CY to excavate exceedances (see Figure 5-3) and soil density of 1.5 ton/CY.	$35	Assumed based on similar items at other sites.	$682,500
	Dewatering, treatment, and disposal	1	LS	Qty assumed to simplify estimate.	$300,000	Assumed based on similar items at other sites.	$300,000
	Ex-situ stabilization to minimize hazardous waste Qty	3,900	Ton	Assumed 80% of soil would be non-hazardous as is, 20% of soil would be treated, 95% of soil being treated would be successfully stabilized during first treatment, and no further treatment would be conducted.	$200	Assumed $165/ton for materials based on Arkema Property bench test dosing and 2019 correspondence with Premier Magnesia and Carus Corporation, and $35/ton for treatment operations.	$780,000
	Dry, load, haul, and dispose of excavated material that is non-hazardous waste at the LRI facility in Graham, Washington	19,305	Ton	Assumed Qty based on assumptions in two previous rows.	$70	Assumed $20/ton for drying/loading, $15/ton for haul, and $35/ton for disposal per 2019 LRI correspondence.	$1,351,350
	Dry, load, haul, treat, and dispose of excavated soil that is hazardous waste at the Waste Management facility in Arlington, Oregon	195	Ton	Assumed Qty based on assumed percentage of soil that was not successfully stabilized.	$687	Assumed $20/ton for drying/loading, and $667/ton for haul, treat, and disposal per 2019 Waste Management correspondence.	$133,965
	Zero valent iron material and delivery cost for backfill	165	Ton	Assumed 10% zero valent iron for one foot backfill layer and density of 1.5 tons/CY.	$2,000	Assumed based on similar items at other sites.	$330,000
	Backfill using overburden soil	5,850	Ton	Assumed Qty equals the Qty from excavation and stockpile overburden soil.	$10	Assumed based on similar items at other sites.	$58,500
	Gravel borrow, haul, and backfill soil excavations	19,500	Ton	Assumed Qty equals the Qty from excavate and stockpile soil with exceedances.	$35	Assumed based on similar items at other sites.	$682,500
	Install performance MWs for long-term GWM	1	LS	Qty assumed to simplify estimate.	$15,000	Assumed based on similar items at other sites.	$15,000
	Contingency (e.g., for larger quantities and/or unit costs)	25	%	Assumed % of the above direct capital construction costs.	N/A	N/A	$1,214,498
						Subtotal (2)	$6,070,000
Indirect Capital Construction Costs	Pre-design investigation work plan, field, lab, and reporting	1	LS	Qty assumed to simplify estimate.	$100,000	Assumed based on anticipated level of effort.	$100,000
	Remedial design and procurement/permitting/ARAR compliance support	1	LS	Qty assumed to simplify estimate.	$100,000	Assumed based on anticipated level of effort.	$100,000
	Permit fees (e.g., grading permit)	1	LS	Qty assumed to simplify estimate.	$25,000	Assumed based on similar items at other sites.	$25,000
	Construction field oversight	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$60,700
	Sampling and analysis costs during construction	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$60,700
	Construction completion report	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$60,700
	Develop and record restrictive covenant	1	LS	Qty assumed to simplify estimate.	$10,000	Assumed based on anticipated level of effort.	$10,000
	Consultant project management	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$60,700
	Port oversight costs	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$60,700
	Ecology oversight costs	1	%	Assumed % of direct capital construction costs.	N/A	N/A	$60,700
						Subtotal (2)	$600,000
Annual or Periodic Costs	GWM field, lab, and reporting (Years 1 - 10)	10	Each	Assumed annual GWM events.	$20,000	Assumed based on anticipated level of effort and 2020 Port correspondence regarding similar items at other Port sites.	$200,000
	MNA evaluations and five year review reports	2	Each	Assumed to occur every 5 years.	$10,000		$20,000
	IC inspections (Years 1 - 10)	10	Each	Assumed annual inspections.	$2,000		$20,000
						Subtotal (2)	$240,000
						Total (2)	**$6,910,000**

Notes:

ARAR: Applicable or relevant and appropriate requirement; CY: cubic yards; GWM: groundwater monitoring; LB: pound; LS: lump sum, N/A: not applicable; Qty: quantity

This cost estimate was prepared solely to facilitate relative comparisons between alternatives for the purposes of this Report, and is intended to be -30% to +50%. Since this ballpark estimate is based on a variety of simplifying assumptions and PIONEER has no control over the pre-design investigation results, the remedial design, Port requirements, the cost of labor, materials, and equipment, or the nature of a particular competitive bidding process at the time the work would be performed, the estimated costs should not be construed to equal actual implementation costs. It is expected that implementation cost estimates will be refined during remedial design, and then following procurement.

The duration of this alternative was estimated to be ten years (see Table 6-3). Costs for IC inspections (to ensure the NBA is still being used for commercial/industrial land use) after the first ten years are incidental to this cost estimate and are not included.

This cost estimate does not include any costs for redevelopment (e.g., installing utilities, installing a paved working surface cap, installing stormwater treatment).

(1) This item includes costs related to health and safety implementation, site control, clearing and grubbing, creating containment areas for stockpiles, stockpile management, dust control, stormwater control, hydroseeding, etc.

(2) Rounded to the nearest $10,000.

Table C-6: Net Present Value for Alternative 3 (Excavate Industrial CLs, MNA, and ICs)

Year	Cost Type	Total Cost	Discount Factor (1)	Net Present Value
0	Direct and indirect capital construction costs (2)	$6,670,000	1.000	$6,670,000
1	Annual or periodic costs	$22,000	0.976	$21,463
2	Annual or periodic costs	$22,000	0.952	$20,940
3	Annual or periodic costs	$22,000	0.929	$20,429
4	Annual or periodic costs	$22,000	0.906	$19,931
5	Annual or periodic costs	$32,000	0.884	$28,283
6	Annual or periodic costs	$22,000	0.862	$18,971
7	Annual or periodic costs	$22,000	0.841	$18,508
8	Annual or periodic costs	$22,000	0.821	$18,056
9	Annual or periodic costs	$22,000	0.801	$17,616
10	Annual or periodic costs	$32,000	0.781	$24,998
			Total Net Present Value of Alternative (3)	**$6,900,000**

Notes:

See Table C-5 for the cost estimate details associated with this alternative. Inflation and depreciation are not included in this estimate.

(1) The net present value was calculated assuming an annual 2.5% discount rate based on input from the Port.

(2) For simplicity, all construction costs were assumed to occur in the base year.

(3) Rounded to nearest $100,000.

Table C-7: Preliminary Cost Estimate for Alternative 4 (Excavate Unrestricted CLs and MNA)

Category	Item Description	Qty	Unit	Basis for Quantity Assumption	Unit Cost	Basis for Unit Cost Assumption	Cost
Direct Capital Construction Costs	Miscellaneous Contractor-prepared plans and permits	1	LS	Qty assumed to simplify estimate.	$30,000	Assumed based on similar items at other sites.	$30,000
	Protect/modify/decommission MWs based on construction areas/activities	1	LS	Qty assumed to simplify estimate.	$10,000	Assumed based on similar items at other sites.	$10,000
	Contractor mobilization and de-mobilization	5	%	Assumed % of the following direct capital construction costs (excluding contingency).	N/A	N/A	$661,470
	Site prep and miscellaneous requirements (1)	1	LS	Qty assumed to simplify estimate.	$50,000	Assumed based on anticipated level of effort.	$50,000
	Excavate and stockpile 0-5 feet bgs overburden soil	495	Ton	Assumed 330 CY to access 5-10 feet bgs soil (see Figure 5-4) and soil density of 1.5 tons/CY.	$35	Assumed based on similar items at other sites.	$17,325
	Excavate and stockpile soil for off-site disposal	72,000	Ton	Assumed 48,000 CY to excavate exceedances (see Figure 5-4) and soil density of 1.5 ton/CY.	$35	Assumed based on similar items at other sites.	$2,520,000
	Dewatering, treatment, and disposal	1	LS	Qty assumed to simplify estimate.	$500,000	Assumed based on similar items at other sites.	$500,000
	Ex-situ stabilization to minimize hazardous waste Qty	7,200	Ton	Assumed 90% of soil would be non-hazardous as is, 10% of soil would be treated, 95% of soil being treated would be successfully stabilized during first treatment, and no further treatment would be conducted.	$200	Assumed $165/ton for materials based on Arkema Property bench test dosing and 2019 correspondence with Premier Magnesia and Carus Corporation, and $35/ton for treatment operations.	$1,440,000
	Dry, load, haul, and dispose of excavated material that is non-hazardous waste at the LRI facility in Graham, Washington	71,640	Ton	Assumed Qty based on assumptions in two previous rows.	$70	Assumed $20/ton for drying/loading, $15/ton for haul, and $35/ton for disposal per 2019 LRI correspondence.	$5,014,800
	Dry, load, haul, treat, and dispose of excavated soil that is hazardous waste at the Waste Management facility in Arlington, Oregon	360	Ton	Assumed Qty based on assumed percentage of soil that was not successfully stabilized.	$687	Assumed $20/ton for drying/loading, and $667/ton for haul, treat, and disposal per 2019 Waste Management correspondence.	$247,320
	Zero valent iron material and delivery cost for backfill	450	Ton	Assumed 10% zero valent iron for one foot backfill layer and density of 1.5 tons/CY.	$2,000	Assumed based on similar items at other sites.	$900,000
	Backfill using overburden soil	495	Ton	Assumed Qty equals the Qty from excavation and stockpile overburden soil.	$10	Assumed based on similar items at other sites.	$4,950
	Gravel borrow, haul, and backfill soil excavations	72,000	Ton	Assumed Qty equals the Qty from excavate and stockpile soil with exceedances.	$35	Assumed based on similar items at other sites.	$2,520,000
	Install performance MWs for long-term GWM	1	LS	Qty assumed to simplify estimate.	$15,000	Assumed based on similar items at other sites.	$15,000
	Contingency (e.g., for larger quantities and/or unit costs)	25	%	Assumed % of the above direct capital construction costs.	N/A	N/A	$3,482,716
						Subtotal (2)	$17,410,000
Indirect Capital Construction Costs	Pre-design investigation work plan, field, lab, and reporting	1	LS	Qty assumed to simplify estimate.	$150,000	Assumed based on anticipated level of effort.	$150,000
	Remedial design and procurement/permitting/ARAR compliance support	1	LS	Qty assumed to simplify estimate.	$150,000	Assumed based on anticipated level of effort.	$150,000
	Permit fees (e.g., grading permit)	1	LS	Qty assumed to simplify estimate.	$50,000	Assumed based on similar items at other sites.	$50,000
	Construction field oversight	0.5	%	Assumed % of direct capital construction costs.	N/A	N/A	$87,050
	Sampling and analysis costs during construction	0.5	%	Assumed % of direct capital construction costs.	N/A	N/A	$87,050
	Construction completion report	0.5	%	Assumed % of direct capital construction costs.	N/A	N/A	$87,050
	Consultant project management	0.5	%	Assumed % of direct capital construction costs.	N/A	N/A	$87,050
	Port oversight costs	0.5	%	Assumed % of direct capital construction costs.	N/A	N/A	$87,050
	Ecology oversight costs	0.5	%	Assumed % of direct capital construction costs.	N/A	N/A	$87,050
						Subtotal (2)	$870,000
Annual or Periodic Costs	GWM field, lab, and reporting (Years 1 - 10)	10	Each	Assumed annual GWM events.	$20,000	Assumed based on anticipated level of effort and 2020 Port correspondence regarding similar items at other Port sites.	$200,000
	MNA evaluations and five year review reports	2	Each	Assumed to occur every 5 years.	$10,000		$20,000
						Subtotal (2)	$220,000
						Total (2)	**$18,500,000**

Notes:

ARAR: Applicable or relevant and appropriate requirement; CY: cubic yards; GWM: groundwater monitoring; LB: pound; LS: lump sum, N/A: not applicable; Qty: quantity

This cost estimate was prepared solely to facilitate relative comparisons between alternatives for the purposes of this Report, and is intended to be -30% to +50%. Since this ballpark estimate is based on a variety of simplifying assumptions and PIONEER has no control over the pre-design investigation results, the remedial design, Port requirements, the cost of labor, materials, and equipment, or the nature of a particular competitive bidding process at the time the work would be performed, the estimated costs should not be construed to equal actual implementation costs. It is expected that implementation cost estimates will be refined during remedial design, and then following procurement.

The duration of this alternative was estimated to be ten years (see Table 6-3).

This cost estimate does not include any costs for redevelopment (e.g., installing utilities, installing a paved working surface cap, installing stormwater treatment).

(1) This item includes costs related to health and safety implementation, site control, clearing and grubbing, creating containment areas for stockpiles, stockpile management, dust control, stormwater control, hydroseeding, etc.

(2) Rounded to the nearest $10,000.

Table C-8: Net Present Value for Alternative 4 (Excavate Unrestricted CLs and MNA)

Year	Cost Type	Total Cost	Discount Factor [1]	Net Present Value
0	Direct and indirect capital construction costs [2]	$18,280,000	1.000	$18,280,000
1	Annual or periodic costs	$20,000	0.976	$19,512
2	Annual or periodic costs	$20,000	0.952	$19,036
3	Annual or periodic costs	$20,000	0.929	$18,572
4	Annual or periodic costs	$20,000	0.906	$18,119
5	Annual or periodic costs	$30,000	0.884	$26,516
6	Annual or periodic costs	$20,000	0.862	$17,246
7	Annual or periodic costs	$20,000	0.841	$16,825
8	Annual or periodic costs	$20,000	0.821	$16,415
9	Annual or periodic costs	$20,000	0.801	$16,015
10	Annual or periodic costs	$30,000	0.781	$23,436
			Total Net Present Value of Alternative [3]	**$18,500,000**

Notes:

See Table C-7 for the cost estimate details associated with this alternative. Inflation and depreciation are not included in this estimate.

[1] The net present value was calculated assuming an annual 2.5% discount rate based on input from the Port.

[2] For simplicity, all construction costs were assumed to occur in the base year.

[3] Rounded to nearest $100,000.

Appendix D

PIONEER TECHNOLOGIES CORPORATION

Table D-1: Dissolved Arsenic Concentrations in 3A3-1/1R

MW ID	Sample Date	Dissolved Arsenic Concentration (ug/L)	Note
3A3-1	11/1/1988	430	
3A3-1	7/1/1989	40	
3A3-1	1/1/1990	320	The total arsenic result used since there was no dissolved arsenic result.
3A3-1	1/1/1997	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	5/1/1997	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	9/1/1997	200	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	1/1/1998	200	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table. Excluded this result from the Ecology Temporal Analysis Tool calculation since the tool only has 20 rows for input.
3A3-1	5/1/1998	200	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table. Excluded this result from the Ecology Temporal Analysis Tool calculation since the tool only has 20 rows for input.
3A3-1	9/1/1998	200	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	9/1/1999	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	1/1/2000	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	6/1/2000	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	9/1/2000	960	
3A3-1	1/1/2001	610	
3A3-1	5/1/2001	280	
3A3-1	12/1/2001	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	9/1/2002	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	4/1/2003	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1	5/1/2003	100	Dissolved arsenic was not detected in this sample. The concentration was assumed to be half of the reporting limit as shown in this table.
3A3-1R	11/14/2008	28	
3A3-1R	5/8/2012	30	
3A3-1R	10/16/2017	58	

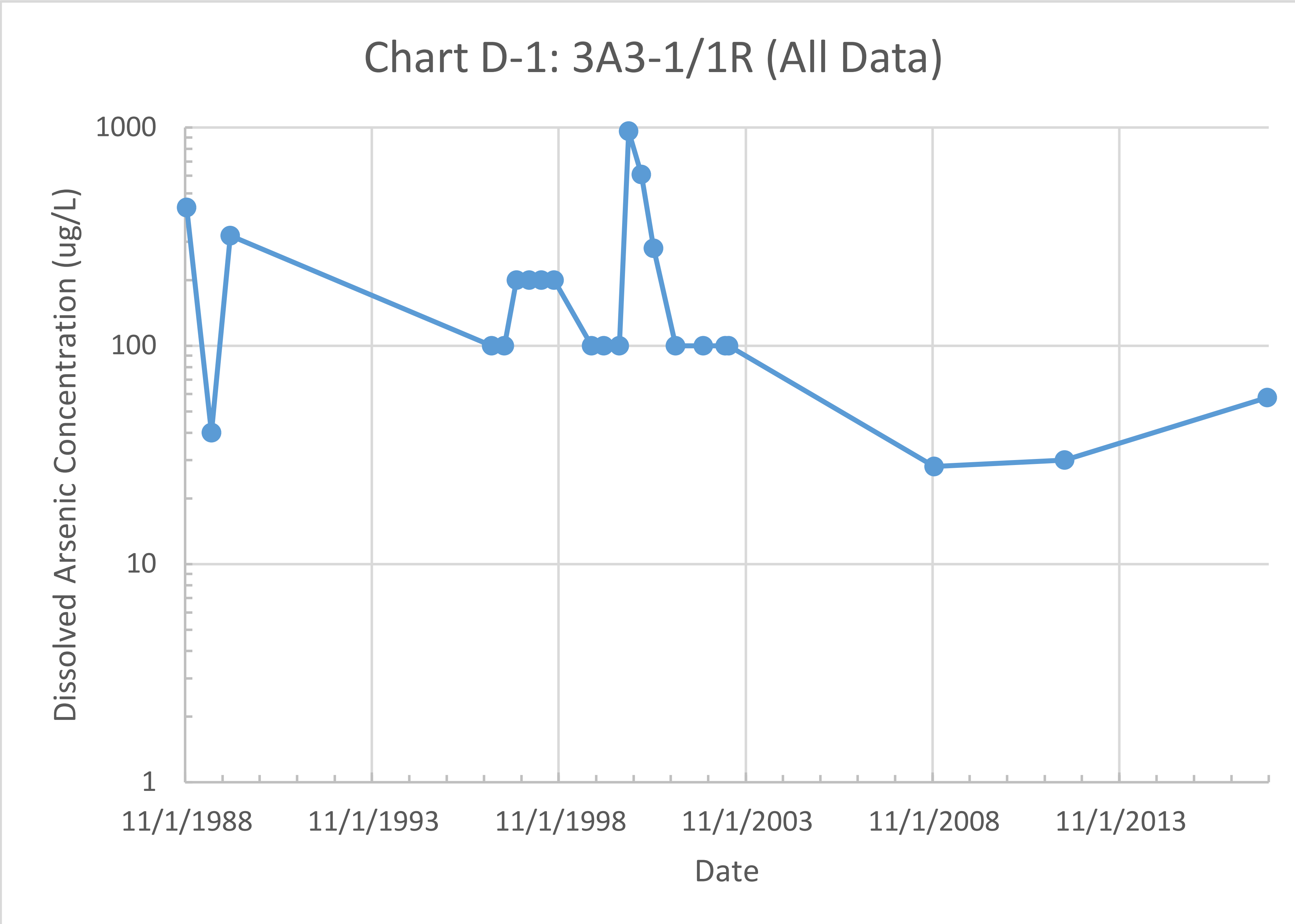


Chart D-1: 3A3-1/1R (All Data)
Dissolved Arsenic Concentration (ug/L)
1000
100
10
1
11/1/1988
11/1/1993
11/1/1998
11/1/2003
11/1/2008
11/1/2013
Date

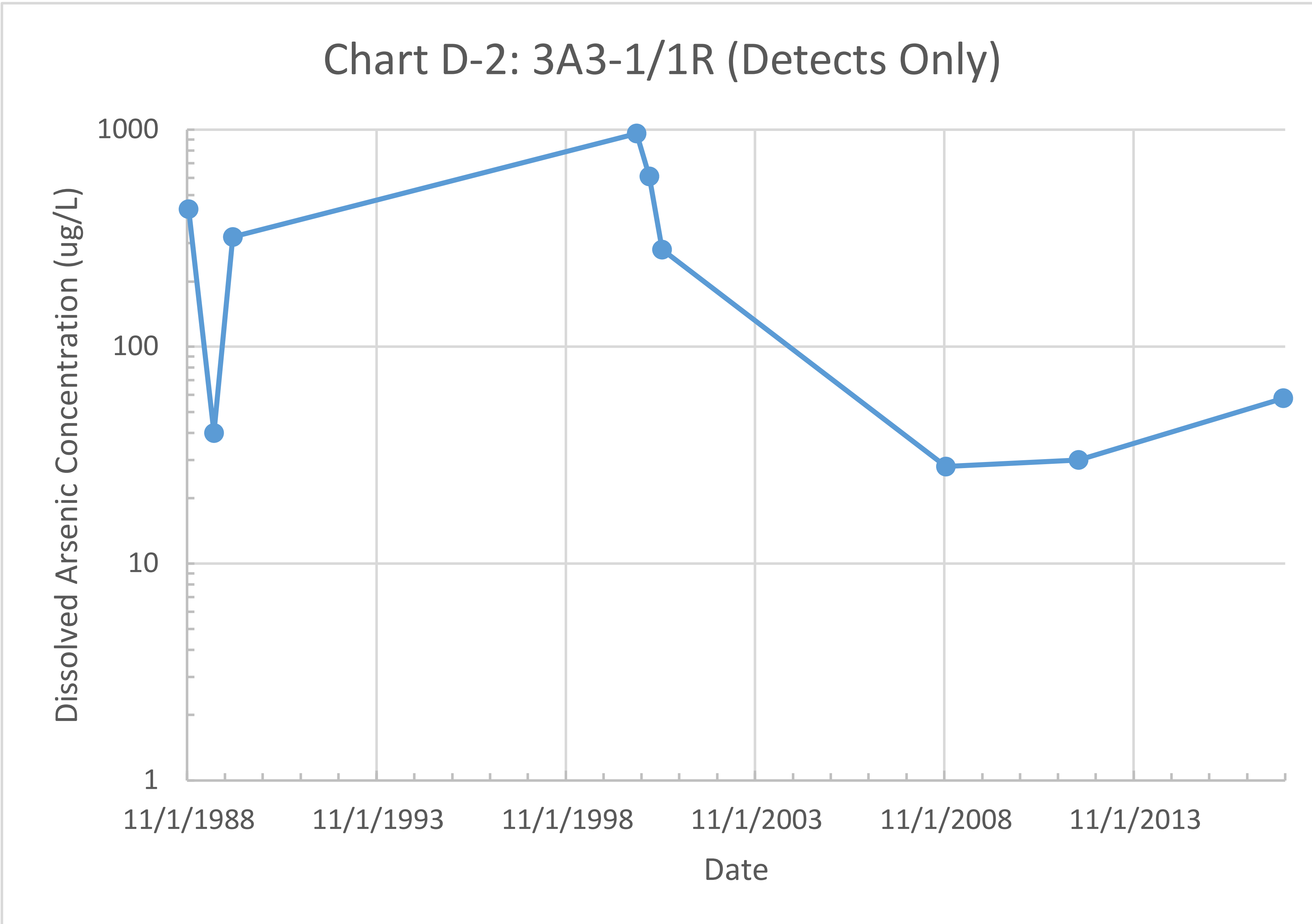
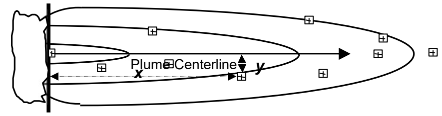


Chart D-2: 3A3-1/1R (Detects Only)
Dissolved Arsenic Concentration (ug/L)
1000
100
10
1
11/1/1988
11/1/1993
11/1/1998
11/1/2003
11/1/2008
11/1/2013
Date

Module 2: Inputs: Enter Historical Ground Water Data



Site Name:	*Former USG Taylor Way Plant Site*
Site Address:	*Tacoma, WA*
Additional Description:	*3A3-1/1R (Likely Shoreline POC MW for NBA)*
Hazardous Substance	*Dissolved Arsenic*

1. Monitoring Well information: Contaminant Concentration at a well:

Note: relationship of "y/x ≤ 0.33" is preferred

Well Location:		Unit		3A3-1/1R (All)	3A3-1/1R (Detects)														
Dist from source, x-direction		ft																	
Off-centerline dist, y-direction		ft																	
Sampling Event	Date sampled	day	Unit of concentration is ug/L																
#1	11/1/1988	0		430	430														
#2	7/1/1989	242		40	40														
#3	1/1/1990	426		320	320														
#4	1/1/1997	2983		100															
#5	5/1/1997	3103		100															
#6	9/1/1997	3226		200															
#7	9/1/1998	3591		200															
#8	9/1/1999	3956		100															
#9	1/1/2000	4078		100															
#10	6/1/2000	4230		100															
#11	9/1/2000	4322		960	960														
#12	1/1/2001	4444		610	610														
#13	5/1/2001	4564		280	280														
#14	12/1/2001	4778		100															
#15	9/1/2002	5052		100															
#16	4/1/2003	5264		100															
#17	5/1/2003	5294		100															
#18	11/14/2008	7318		28	28														
#19	5/8/2012	8589		30	30														
#20	10/16/2017	10576		58	58														
Average Concentration			na	203	306	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Maximum Concentration			NA	960	960	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Minimum Concentration			NA	28	28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

2. Groundwater Elevation:

Well Location:		
Sampling Event	Date sampled	Day
#1	11/1/88	0
#2	7/1/89	242
#3	1/1/90	426
#4	1/1/97	2983
#5	5/1/97	3103
#6	9/1/97	3226
#7	9/1/98	3591
#8	9/1/99	3956
#9	1/1/00	4078
#10	6/1/00	4230
#11	9/1/00	4322
#12	1/1/01	4444
#13	5/1/01	4564
#14	12/1/01	4778
#15	9/1/02	5052
#16	4/1/03	5264
#17	5/1/03	5294
#18	11/14/08	7318
#19	5/8/12	8589
#20	10/16/17	10576

Module 2: Temporal Analysis: Concentration of contaminant vs. time (Regression Analysis at each well)

Site Name: *Former USG Taylor Way Plant Site*
Site Address: *Tacoma, WA*
Additional Description: *3A3-1/1R (Likely Shoreline POC MW for NBA)*
Hazardous Substance *Dissolved Arsenic*

1. Level of Confidence (Decision Criteria)? **85%**

2. Prediction: Calculation of Restoration Time and Predicted Concentration at Wells

Well Location		NA	3A3-1/1R (All)	3A3-1/1R (Detects)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A. Cleanup Level (Criterion) to be achieved?	ug/L		5	5													
A.1 Average (@50% CL[1] best-fitting values)																	
Time to reach the criterion	yr	NA	66.89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Date when the Criterion to be achieved	date	NA	9/4/55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A.2 Boundary (@85% CL)																	
Time to reach the criterion[2]	yr	NA	136.72	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Date when the Criterion to be achieved	date	NA	6/20/25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B Date of Prediction?	date																
B.1 Average conc predicted (@50% CL)	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B.2 Boundary conc predicted (@85% CL)	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

3. Log-Linear Regression Results

Coefficient of Determination	r^2	NA	0.195	0.213	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Correlation Coefficient	r	NA	-0.441	-0.462	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Number of data points	n	NA	20	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

4. Statistical Inference on the Slope of the Log-Linear Regression Line with t-statistics

One-tailed Confidence Level calculated, %	NA	94.852%	78.945%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sufficient evidence to support that the slope of the regression line is significantly different from zero?	NA	YES!	NO!	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Coefficient of Variation?	NA	NA	1.047	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plume Stability?	NA	Shrinking	UD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

5. Calculation of Point Decay Rate Constant (k_{point})

Slope: Point decay rate constant (k_{point})	@50% CL	yr^{-1}	NA	0.059	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	@85% CL	yr^{-1}	NA	0.029	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Half Life for (k_{point})	@50% CL	yr	NA	11.737	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	@85% CL	yr	NA	23.992	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

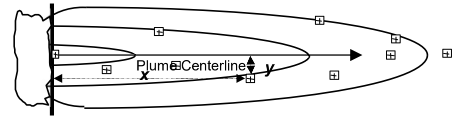
Note: 1. CL : Confidence Level; UD= Undetermined

2. The length of time that will actually be required is estimated to be no more than years calculated (@ 85% of confidence level.)

Table B-3
Surface Aquifer Metals Concentrations
Taylor Way Property Supplemental Remedial Investigation
Tacoma, Washington

Metal and Preliminary Cleanup Level[a] (µg/L)	Method Reporting Limit[b] (µg/L)	Date Sampled	Surface Aquifer Sample I.D. Taylor Way Property Wells — MW1/MW1R µg/L		MW2 µg/L		MW3/MW3B µg/L		MW4 µg/L		MW5 µg/L		MW6 µg/L		MW9 µg/L		MW10 µg/L		MW12 µg/L	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Antimony	50	03/28/94	ND	ND	ND	ND	19	18	280	290	ND	ND	79	76	--	--	--	--	--	--
		11/09/94	ND	ND	ND	ND	ND	ND	95	84	ND	ND	ND	ND	520	750	ND	ND	ND	ND
640		03/31/98	77	66	ND	ND	ND	ND	150	160	ND	ND	63	79	4,500	4,200	ND	ND	ND	ND
		10/23/98	200	220	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		04/15-16/99	190	92	ND	ND	ND	ND	<200 [c]J	<100 [c]	<250 [c]	<250 [c]	<250 [c]	<250 [c]	1.9	1.7	ND	ND	ND	ND
		01/19-20/00	ND	ND	ND	ND	250	250	98	98	ND	ND	ND	ND	58 J	69 J	ND	ND	ND	ND
	5.6	04/21/00	45 J	--	ND	--	ND	--	100/150 [d]J	--	ND UJ	--	ND	--	200 J	--	ND	ND	ND UJ	--
		08/16/00	53	--	ND	--	5.90	--	40	--	ND	--	ND	--	78	--	ND	--	ND	ND
		10/25/00	33	--	ND	--	ND	--	48	--	ND	--	8.3	--	73	71	ND	--	ND	--
		01/25-26/01	29	--	ND	--	ND	--	34	--	ND	--	ND	--	56	--	ND	--	ND	--
		04/26-27/01	18	--	ND	--	ND	--	47	--	ND	--	ND	--	100	--	ND	--	ND	--
		07/26-27/01	120	--	ND	--	--	--	--	50	ND	--	ND	--	120	--	ND	--	--	--
		10/25-26/01	43	--	ND	--	ND	--	100	90	ND	--	6.2	--	84	--	ND	--	--	--
		10/02-11/02[e]	23	--	--	--	<3	--	39	--	3	--	3.5	--	58	--	--	--	--	--
		12/18-20/06	7.1/6.9 [d]	6/6 [d]	6.5	5.6	Well Abandoned		14	10.8	1.8/1.9 [d]	1.8/1.8 [d]	1.5	2	47.3	46.8	Well Abandoned		Well Abandoned	
		08/27-9/3/08	3.7	3.3	--	--			--	--	2.4	2.4	1.8	1.8	52.7	55.4				
		06/2-3/09	4.8	4.4	--	--			--	--	2.5	2.3	--	--	--	--				
Arsenic	5	03/28/94	1,600	1,600	1,900	1,800	430	350	39	36	<10 [c]	<10 [c]	140	130	--	--	--	--	--	--
		11/09/94	1,400	1,500	290	260	170	220	12	17	ND	ND	13	12	1,900	2,500	ND	ND	7.9	ND
5		03/31/98	520	480	2,900	3,000	120	110	29	27	ND	ND	130	130	19,000	19,000	ND	ND	ND	ND
	3	10/23/98	1,200	1,300	140	130	100	92	7.7	7.7	ND	ND	ND	ND	2,800	2,600	ND	ND	ND	ND
	5	04/15-16/99	400	370	220	190	21	19	35	28	<10 [c]	<10 [c]	<10 [c]	<10 [c]	9,600	7,600	<10 [c]	<10 [c]	<10 [c]	<10 [c]
		01/19-20/00	610	620	650	660	110 J	180 J	26 J	53 J	ND	ND	12	13	180	170	ND	ND	ND	ND
	3.3	04/21/00	520 J	--	390	--	140	--	46/140 [d]J	--	7.1 J	--	15	--	350 J	--	7.7	4.7	ND UJ	NA
		08/16/00	480	--	400	--	52	--	8.8	--	6.7	--	15	--	120	--	ND	--	5.2	5.9
		10/25/00	490	--	240	--	34	--	25	--	20	--	24	--	1,500	1,500	5.2	--	ND	--
		01/25-26/01	520	--	220	--	34	--	19	--	6.9	--	28	--	110	--	4.4	--	ND	--
		04/26-27/01	630	--	830	--	22	--	28	--	7.6	--	17	--	110	--	ND	--	ND	--
		07/26-27/01	650	--	260	--	--	--	--	22	6	--	20	--	130	--	13	--	--	--
		10/25-26/01	520	--	120	--	85	--	21	22	ND	--	6.5	--	160	--	ND	--	--	--
		10/02-11/02[e]	356	--	--	--	26.5	--	22.2	--	1.5	--	1.9	--	382	--	--	--	--	--
		12/18-20/06	786/771 [d]	737/768 [d]	105	112	Well Abandoned		26	23.2	1.6/1.7 [d]	1.8/1.9 [d]	3.1	4	36.2	35	Well Abandoned		Well Abandoned	
		08/27-9/3/08	523	510	--	--			--	--	1.9	1.5	2.8	1.5	89.5	90				
		06/2-3/09	1,750	1,790	--	--			--	--	3	1.4	--	--	--	--				
		05/2012[f]	--	1,100	--	114			--	16	--	1.7	--	3.5	--	40				
Arsenic (III)		08/29-9/2/08	474	--	--	--			--	--	--	--	--	--	27	--				
Arsenic (V)		08/29-9/2/08	25	--	--	--			--	--	--	--	--	--	42.7	--				

Module 2: Inputs: Enter Historical Ground Water Data



Site Name:	*Former USG Taylor Way Plant Site*
Site Address:	*Tacoma, WA*
Additional Description:	*MW9*
Hazardous Substance	*Total/Dissolved Arsenic*

1. Monitoring Well information: Contaminant Concentration at a well: Note: relationship of "y/x ≤ 0.33" is preferred

Well Location:		Unit		MW9 Total	MW9 Diss													
Dist from source, x-direction		ft																
Off-centerline dist, y-direction		ft																
Sampling Event	Date sampled	day	Unit of concentration is ug/L															
#1	11/9/1994	0		1900	2500													
#2	3/31/1998	1238		19000	19000													
#3	10/23/1998	1444		2800	2600													
#4	4/15/1999	1618		9600	7600													
#5	1/19/2000	1897		180	170													
#6	4/21/2000	1990		350														
#7	8/16/2000	2107		120														
#8	10/25/2000	2177		1500	1500													
#9	1/25/2001	2269		110														
#10	4/26/2001	2360		110														
#11	7/26/2001	2451		130														
#12	10/25/2001	2542		160														
#13	10/2/2002	2884		382														
#14	12/18/2006	4422		36	35													
#15	8/27/2008	5040		90	90													
#16	5/1/2012	6383			40													
#17																		
#18																		
#19																		
#20																		
Average Concentration			na	2431	3726	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Maximum Concentration			NA	19000	19000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Minimum Concentration			NA	36	35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

2. Groundwater Elevation:

Well Location:																		
Sampling Event	Date sampled	Day																
#1	11/9/94	0																
#2	3/31/98	1238																
#3	10/23/98	1444																
#4	4/15/99	1618																
#5	1/19/00	1897																
#6	4/21/00	1990																
#7	8/16/00	2107																
#8	10/25/00	2177																
#9	1/25/01	2269																
#10	4/26/01	2360																
#11	7/26/01	2451																
#12	10/25/01	2542																
#13	10/2/02	2884																
#14	12/18/06	4422																
#15	8/27/08	5040																
#16	5/1/12	6383																
#17																		
#18																		
#19																		
#20																		

Module 2: Temporal Analysis: Concentration of contaminant vs. time (Regression Analysis at each well)

Site Name: *Former USG Taylor Way Plant Site*
Site Address: *Tacoma, WA*
Additional Description: *MW9*
Hazardous Substance *Total/Dissolved Arsenic*

1. Level of Confidence (Decision Criteria)? 85%

2. Prediction: Calculation of Restoration Time and Predicted Concentration at Wells

Well Location		NA	MW9 Total	MW9 Diss	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A. Cleanup Level (Criterion) to be achieved?	ug/L		5	5													
A.1 Average (@50% CL[1] best-fitting values)																	
Time to reach the criterion	yr	NA	18.29	22.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Date when the Criterion to be achieved	date	NA	2/18/13	11/5/16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A.2 Boundary (@85% CL)																	
Time to reach the criterion[2]	yr	NA	27.70	31.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Date when the Criterion to be achieved	date	NA	7/16/22	11/3/25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B Date of Prediction?	date																
B.1 Average conc predicted (@50% CL)	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B.2 Boundary conc predicted (@85% CL)	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

3. Log-Linear Regression Results

Coefficient of Determination	r^2	NA	0.436	0.676	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Correlation Coefficient	r	NA	-0.660	-0.822	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Number of data points	n	NA	15	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

4. Statistical Inference on the Slope of the Log-Linear Regression Line with t-statistics

One-tailed Confidence Level calculated, %	NA	99.259%	99.345%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sufficient evidence to support that the slope of the regression line is significantly different from zero?	NA	YES!	YES!	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Coefficient of Variation?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plume Stability?	NA	Shrinking	Shrinking	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

5. Calculation of Point Decay Rate Constant (k_{point})

Slope: Point decay rate constant (k_{point})	@50% CL	yr^{-1}	NA	0.372	0.335	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	@85% CL	yr^{-1}	NA	0.245	0.238	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Half Life for (k_{point})	@50% CL	yr	NA	1.865	2.066	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	@85% CL	yr	NA	2.825	2.911	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: 1. CL : Confidence Level; UD= Undetermined

2. The length of time that will actually be required is estimated to be no more than years calculated (@ 85% of confidence level.)