

FINAL

PILOT STUDY BASELINE AND MONTHLY POST-INJECTION PERFORMANCE MONITORING REPORT

FORMER ATLAS “D” MISSILE SITE 4
F.E. WARREN AIR FORCE BASE, WYOMING
FUDS ID: B08WY0467



September 2021

United States Army Corps of Engineers
Omaha District



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SEPTEMBER 24, 2021

Prepared for:



United States Army Corps of Engineers
Contract W912DY-16-D-0026, TO W9128F19F0192

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List of Acronyms

µg/L	micrograms per liter
DO	dissolved oxygen
KMnO ₄	potassium permanganate
L&SB	Launch and Service Building
LTM	long-term monitoring
MCL	maximum contaminant level
MEE	methane, ethane, ethene
mg/L	milligram per liter
No.	number
ORP	oxygen-reduction potential
QA/QC	quality assurance/quality control
RSK	Robert S. Kerr
RSL	regional screening level
SCFS	sample collection field sheet
Site 4	Atlas “D” Missile Site 4
SOP	Standard Operating Procedure
TAL	target analyte list
TCE	trichloroethene
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
URS	URS Group, Inc.
USEPA	United States Environmental Protection Agency
VOA	volatile organic analysis
VOC	volatile organic compound
ZVI	zero-valent iron

1.1 LOCATION

The F.E. Warren Air Force Base Former Atlas “D” Missile Site 4 (Site 4) is located in Laramie County, Wyoming, approximately 2 miles south of Interstate 80 and approximately 18 miles west of the City of Cheyenne (**Figure 1-1**). The missile site covers approximately 700 acres owned by the City of Cheyenne and is a small portion of the Belvoir Ranch. Site 4 housed three Atlas “D” missiles in three Launch and Service Buildings (L&SBs). The one-square-mile area around the former missile site is the source area for trichloroethene (TCE) contamination (also known as Area A). Other areas downgradient of Area A have been investigated and identified as containing contamination. These areas include:

- The Transition Area: a 12-square-mile area that extends eastward from Area A where the plume transitions from the White River Formation to the Ogallala Formation.
- Area B: a 30-square-mile area east of the Cow Camp well and includes the Borie Well Field.
- The Expanded Study Area: an area east and southeast of Area B.

1.2 AUTHORITY

URS Group, Inc. (URS) has been contracted by the United States Army Corps of Engineers Omaha District under Contract Number (No.) W912DY-16-D-0026, Task Order W9128F19F0192 to conduct a feasibility study, data gaps investigation, and long-term monitoring (LTM) at Site 4. These environmental restoration activities are conducted under the Comprehensive Environmental Response, Compensation, and Liability Act.

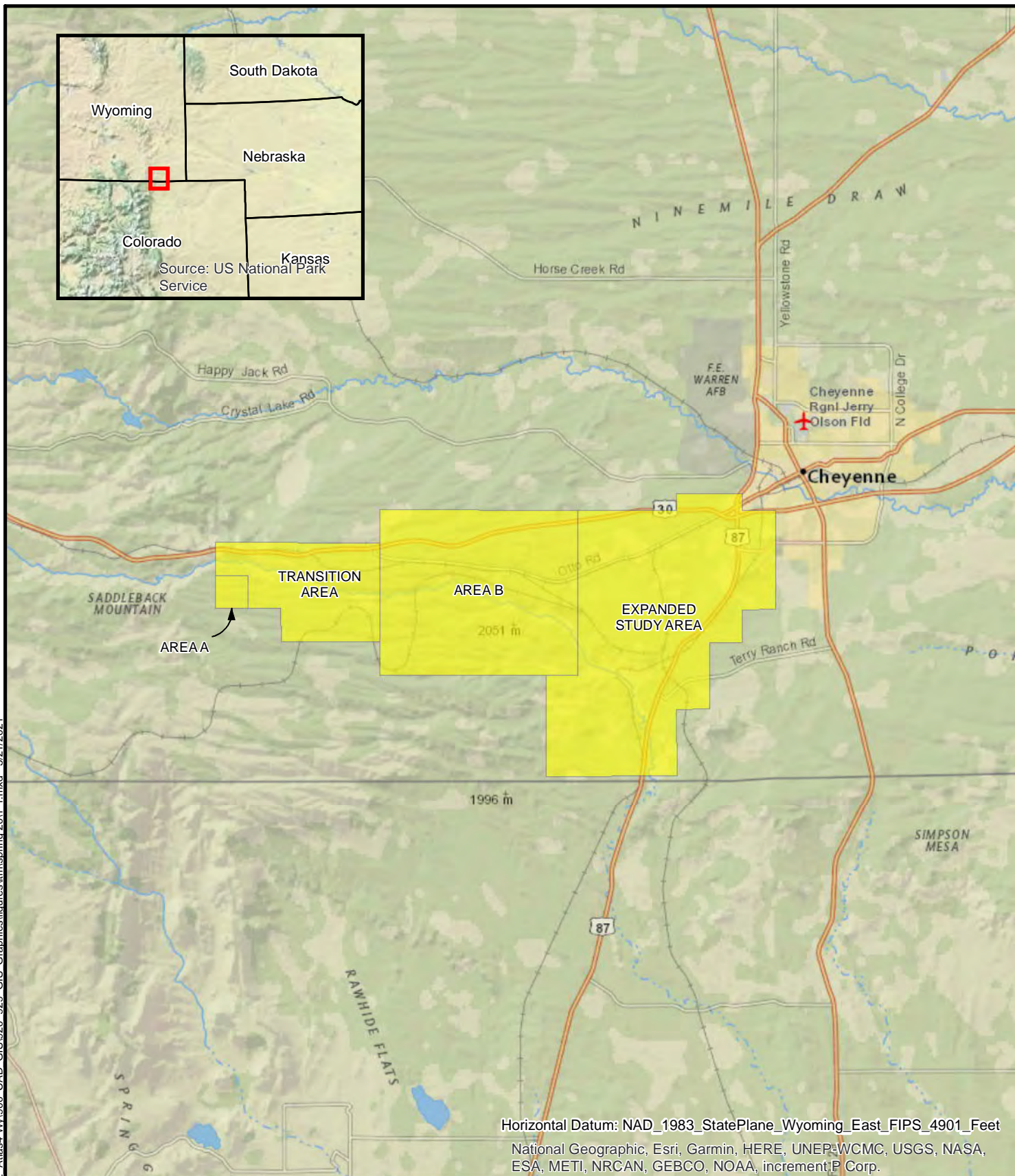
1.3 PURPOSE AND SCOPE

A pilot study with two *in situ* remediation technologies was conducted at the source area (Area A). *In situ* treatments via injection of potassium permanganate (KMnO₄) and zero-valent iron (ZVI) were selected to test remediation of source area contamination at L&SB 1 and L&SB 2, respectively. ZVI was injected at L&SB 2 in two different areas using pneumatic injection (pilot study area 2A and at IP05 and IP06 at pilot study area 2B) and hydraulic injection (at IP04 only in pilot study area 2B) methods to evaluate the effectiveness of each. Pneumatic injection had the most success and was subsequently used for injection of KMnO₄ at L&SB 1 (pilot study area 1).

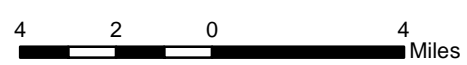
This Pilot Study Post-Injection Performance Monitoring Report provides the results of the baseline and monthly performance monitoring sampling completed within the pilot study areas. Collection and analysis of performance monitoring data will be used to evaluate injection effectiveness and the potential need for mitigation injections under a full-scale application of the *in situ* remediation to address contaminant rebound. Baseline samples were collected prior to completing injections, and monthly performance monitoring samples were collected post-injection for three sampling events.

The Injection Pilot Study Work Plan (URS 2020) outlined the *in situ* treatment design, implementation, performance monitoring, and subsequent data evaluation and reporting. Sampling and field activities were completed in accordance with the Site Wide Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) (URS 2020a) and LTM and Performance Monitoring UFP-QAPP Addendum 1 (URS 2020b), and health and safety procedures outlined in the Accident Prevention Plan (URS 2020c).

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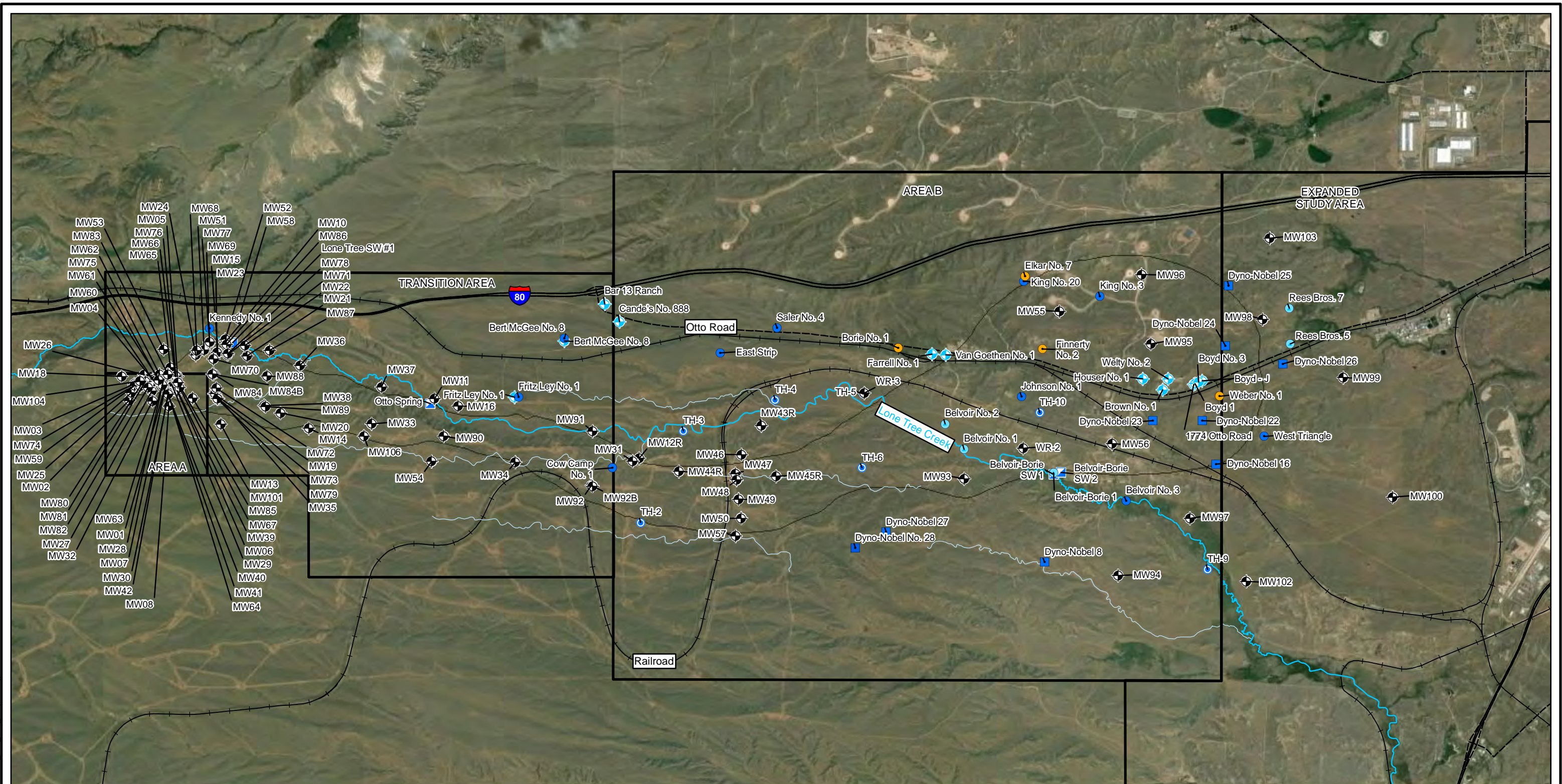


Horizontal Datum: NAD_1983_StatePlane_Wyoming_East_FIPS_4901_Feet
National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.



Site Location Map			
Spring 2020 LTM Event 15			
Former Atlas "D" Missile Site 4			
F.E. Warren Air Force Base, WY			
Drawn By: DPG	Date: 5/21/2021	Project No: 60613342	Figure 1-1
Checked By: RRM	Revision: 0		

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Locator Map

Legend

- Monitoring Well
- Industrial Well
- Irrigation Well
- Municipal Well
- Stock Well
- Test Hole Well
- Surface Water/Sediment Location
- Domestic
- Road
- Railroad Tracks
- Perennial Creek
- Ephemeral Creek
- LTM = long-term monitoring

Horizontal Datum:
NAD_1983_StatePlane_Wyoming_East_FIPS_4901_Feet

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

5,000 2,500 0 5,000 Feet

Study Area Details
Fall 2020 LTM Event 16
Former Atlas "D" Missile Site 4
F.E. Warren Air Force Base, WY

Drawn By: DPG	Date: 5/21/2021	Project No: 60613342	Figure 1-2
Checked By: IBK	Revision: 0		

Baseline groundwater samples were collected prior to injection. Post-injection performance monitoring sampling was completed monthly for three sampling events following injection. Additional quarterly performance monitoring will follow for the remainder of the performance period (anticipated to end January 2022). Performance sampling events occurred and will continue to occur concurrently with LTM sampling activities when possible. Since only one sample identification can be assigned per sample, the Fall 2020 LTM Event 16 sample identification was assigned to the first groundwater sample collected after the start of the Fall 2020 LTM Event 16 sampling activities. However, the samples serve a dual purpose to evaluate the performance monitoring trends and monitor contaminant concentrations and trends through LTM. A summary of groundwater samples collected during the baseline and subsequent monthly performance monitoring sampling activities is shown in **Table 2-1**.

Samples were collected, identified, documented, and handled in accordance with the LTM and Performance Monitoring UFP-QAPP, Addendum 1 (URS 2020b). Sample collection field sheets (SCFSs) completed during the pilot study sampling events are included in **Appendix A**. Daily Quality Control Reports are included in **Appendix B**. Samples were shipped in accordance with Standard Operating Procedure (SOP) 2 (URS 2020a). The groundwater samples were sent to Agriculture & Priority Pollutants Laboratories, Inc. in Clovis, California.

2.1 KMnO₄ INJECTIONS AT L&SB 1 - PILOT STUDY AREA 1

Post-injection performance monitoring samples within the KMnO₄ pilot study area 1 (**Figure 2-1**) were collected at monitoring wells MW59-74, MW59-125, and MW74-104. Performance monitoring activities and injections were completed as follows:

- Performance Monitoring Event 1 (Baseline): Baseline samples were collected between May 27 and June 28, 2020 for volatile organic compounds (VOCs) only, during the Spring 2020 LTM Event 15. Baseline samples for target analyte list (TAL) metals and hexavalent chromium were collected on July 19, 2020. Hexavalent chromium was included in the analysis for baseline samples; however, samples for hexavalent chromium analysis were only proposed for the first and last sampling events post-injection (approximately 1 and 18 months post-injection, respectively).
- KMnO₄ Injections: KMnO₄ injections were complete between August 7 and 21, 2020 at IP01, IP02, IP03, and IP10 as detailed in the Injection Completion Report (URS 2021a).
- Performance Monitoring Event 2: The first monthly performance monitoring sampling event was completed concurrent with the Fall 2020 LTM Event 16 sampling event between September 23 and 28, 2020.
- Performance Monitoring Event 3: The second monthly performance monitoring sampling event was completed between October 22 and 23, 2020.
- Performance Monitoring Event 4: The third monthly performance monitoring sampling event was completed between December 2 and 6, 2020.

Samples collected from pilot study area 1 were analyzed for VOCs using United States Environmental Protection Agency (USEPA) Method 8260C, TAL Metals using USEPA Method 6020B/7470A, and hexavalent chromium using Method 218.7 (baseline only).

2.2 ZVI INJECTIONS AT L&SB 2 - PILOT STUDY AREA 2A

Post-injection performance monitoring samples within the ZVI pilot study area 2A (**Figure 2-2**) were collected at monitoring wells MW61-80, MW61-107, and MW75-93. Performance monitoring activities and injections were completed as follows:

- Performance Monitoring Event 1 (Baseline): Baseline samples were collected between May 30 and June 27, 2020 for VOCs only, during the Spring 2020 LTM Event 15. Baseline samples for dissolved gasses (methane, ethane, ethene [MEE]) and anion scan (chloride, sulfate, alkalinity) were collected on July 9, 2020.
- ZVI Injections: ZVI injections were completed between July 14 and 19, 2020 at IP07, IP08, and IP09 as detailed in the Injection Completion Report (URS 2021a).
- Performance Monitoring Event 2: The first monthly performance monitoring sampling event was completed between August 20 and 21, 2020.
- Performance Monitoring Event 3: The second monthly performance monitoring sampling event was completed between September 17 and 18, 2020.
- Performance Monitoring Event 4: The third monthly performance monitoring sampling event was completed concurrent with the Fall 2020 LTM Event 16 sampling event between October 20 and 22, 2020.

Samples collected from pilot study area 2A were analyzed for VOCs using USEPA Method 8260C, MEE using Robert S. Kerr Method (RSK)-175, chloride/sulfate using USEPA method 9056A, and alkalinity using USEPA Method 2320B.

2.3 ZVI INJECTIONS AT L&SB 2 - PILOT STUDY AREA 2B

Post-injection performance monitoring samples within the ZVI pilot study area 2B (**Figure 2-2**) were collected at monitoring wells MW60-90 and MW60-146. Performance monitoring activities and injections were completed as follows:

- Performance Monitoring Event 1 (Baseline): Baseline samples were collected on June 28, 2020 for VOCs only, during the Spring 2020 LTM Event 15. Baseline samples for dissolved gasses (MEE) and anion scan (chloride, sulfate, alkalinity) were collected on July 10, 2020.
- ZVI Injections: ZVI injections were completed between July 23 and August 5, 2020 at IP04, IP05, and IP06 as detailed in the Injection Completion Report (URS 2021a).
- Performance Monitoring Event 2: The first monthly performance monitoring sampling event was completed between September 1 and 2, 2020.

- Performance Monitoring Event 3: The second monthly performance monitoring sampling event was completed concurrent with the Fall 2020 LTM Event 16 sampling event on October 14, 2020.
- Performance Monitoring Event 4: The third monthly performance monitoring sampling event was completed on November 7, 2020.

Samples collected from pilot study area 2B were analyzed for VOCs using USEPA Method 8260C, MEE using RSK-175, chloride/sulfate using USEPA method 9056A, and alkalinity using USEPA Method 2320B.

2.4 VARIATIONS FROM THE WORK PLAN

The following variations from the Injection Pilot Study Work Plan (URS 2020) occurred during completion of the performance monitoring events:

- No VOCs were collected at MW59-74 during performance monitoring events on September 23, October 23, or December 2, 2020 due to the presence of KMnO_4 . A VOC sample was collected in a volatile organic analysis (VOA) vial with ascorbic acid to neutralize the KMnO_4 , but the water in the VOA remained dark purple. No VOC sample was submitted to the lab due to the high concentration of KMnO_4 in the well. Additionally, the proposed hexavalent chromium sample during the September 23, 2020 performance monitoring event could not be collected and analyzed due to the presence of KMnO_4 .
- The VOC sample (sample ID: FEW4-MW60-90-PS2B-2) for MW60-90 during the second performance sampling event on September 2, 2020 was inadvertently not collected or sent to the laboratory.

TABLE 2-1
SUMMARY OF SAMPLES COLLECTED DURING PERFORMANCE MONITORING
FORMER ATLAS "D" MISSILE SITE 4

Injection Area	Well Identification	Sample Identification ¹	Sample Date	Well Type	VOCs (8260C)	PSOD	MEE (RSK-175)	Chloride/Sulfate (9056A)	Alkalinity (2320B)	TAL Metals (6020B)	Mercury (7470A)	Hexavalent Chromium (218.7)	Duplicate	MS/MSD	KMnO ₄ Present	ZVI Present	Duplicate Sample Identification
KMnO ₄ Performance Area 1	MW59-74	FEW4-MW59-74-15	5/27/2020	Monitoring (P)	X	X											
		FEW4-MW59-74-PS1-1	7/19/2020	Monitoring (P)						X	X	X					
		FEW4-MW59-74-16	9/23/2020	Monitoring (P)						X	X				X		
		FEW4-MW59-74-PS1-3	10/23/2020	Monitoring (P)						X	X				X		
		FEW4-MW59-74-PS1-4	12/2/2020	Monitoring (P)						X	X				X		
	MW59-125	FEW4-MW59-125-15	6/28/2020	Monitoring (P)	X												
		FEW4-MW59-125-PS1-1	7/19/2020	Monitoring (P)						X	X	X					
		FEW4-MW59-125-16	9/28/2020	Monitoring (P)	X					X	X	X					
		FEW4-MW59-125-PS1-3	10/23/2020	Monitoring (P)	X					X	X						
		FEW4-MW59-125-PS1-4	12/6/2020	Monitoring (P)	X					X	X						
	MW74-104	FEW4-MW74-104-15	6/26/2020	Monitoring (P)	X												
		FEW4-MW74-104-PS1-1	7/19/2020	Monitoring (P)						X	X	X					
		FEW4-MW74-104-16	9/24/2020	Monitoring (P)	X					X	X	X					
		FEW4-MW74-104-PS1-3	10/22/2020	Monitoring (P)	X					X	X						
		FEW4-MW74-104-PS1-4	12/5/2020	Monitoring (P)	X					X	X			X			
ZVI Performance Area 2A	MW61-80	FEW4-MW61-80-15	6/27/2020	Monitoring (P)	X												
		FEW4-MW61-80-PS2A-1	7/9/2020	Monitoring (P)			X	X	X				X	X			FEW4-MW61-80-PS2A-1-B
		FEW4-MW61-80-PS2A-2	8/20/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW61-80-PS2A-3	9/17/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW61-80-16	10/20/2020	Monitoring (P)	X		X	X	X								
	MW61-107	FEW4-MW61-107-15	6/27/2020	Monitoring (P)	X												
		FEW4-MW61-107-PS2A-1	7/9/2020	Monitoring (P)			X	X	X								
		FEW4-MW61-107-PS2A-2	8/20/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW61-107-PS2A-3	9/17/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW61-107-16	10/22/2020	Monitoring (P)	X		X	X	X								
	MW75-93	FEW4-MW75-93-15	5/30/2020	Monitoring (P)	X												
		FEW4-MW75-93-PS2A-1	7/9/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW75-93-PS2A-2	8/21/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW75-93-PS2A-3	9/18/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW75-93-16	10/22/2020	Monitoring (P)	X		X	X	X								

TABLE 2-1
SUMMARY OF SAMPLES COLLECTED DURING PERFORMANCE MONITORING
FORMER ATLAS "D" MISSILE SITE 4

Injection Area	Well Identification	Sample Identification ¹	Sample Date	Well Type	VOCs (8260C)	PSOD	MEE (RSK-175)	Chloride/Sulfate (9056A)	Alkalinity (2320B)	TAL Metals (6020B)	Mercury (7470A)	Hexavalent Chromium (218.7)	Duplicate	MS/MSD	KMnO ₄ Present	ZVI Present	Duplicate Sample Identification
ZVI Performance Area 2B	MW60-90	FEW4-MW60-90-15	6/28/2020	Monitoring (P)	X												
		FEW4-MW60-90-PS2B-1	7/10/2020	Monitoring (P)			X	X	X								
		FEW4-MW60-90-PS2B-2	9/2/2020	Monitoring (P)			X	X	X								
		FEW4-MW60-90-16	10/14/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW60-90-PS2B-4	11/7/2020	Monitoring (P)	X		X	X	X								
	MW60-146	FEW4-MW60-146-15	6/28/2020	Monitoring (P)	X												
		FEW4-MW60-146-PS2B-1	7/10/2020	Monitoring (P)			X	X	X								
		FEW4-MW60-146-PS2B-2	9/1/2020	Monitoring (P)	X		X	X	X							X	
		FEW4-MW60-146-16	10/14/2020	Monitoring (P)	X		X	X	X								
		FEW4-MW60-146-PS2B-4	11/7/2020	Monitoring (P)	X		X	X	X								

Notes:

¹Sample identification uses the following naming scheme: site identification-well/location identification-sample event.

KMnO₄ = potassium permanganate

MS/MSD = matrix spike/matrix spike duplicate

MEE = methane, ethane, ethene

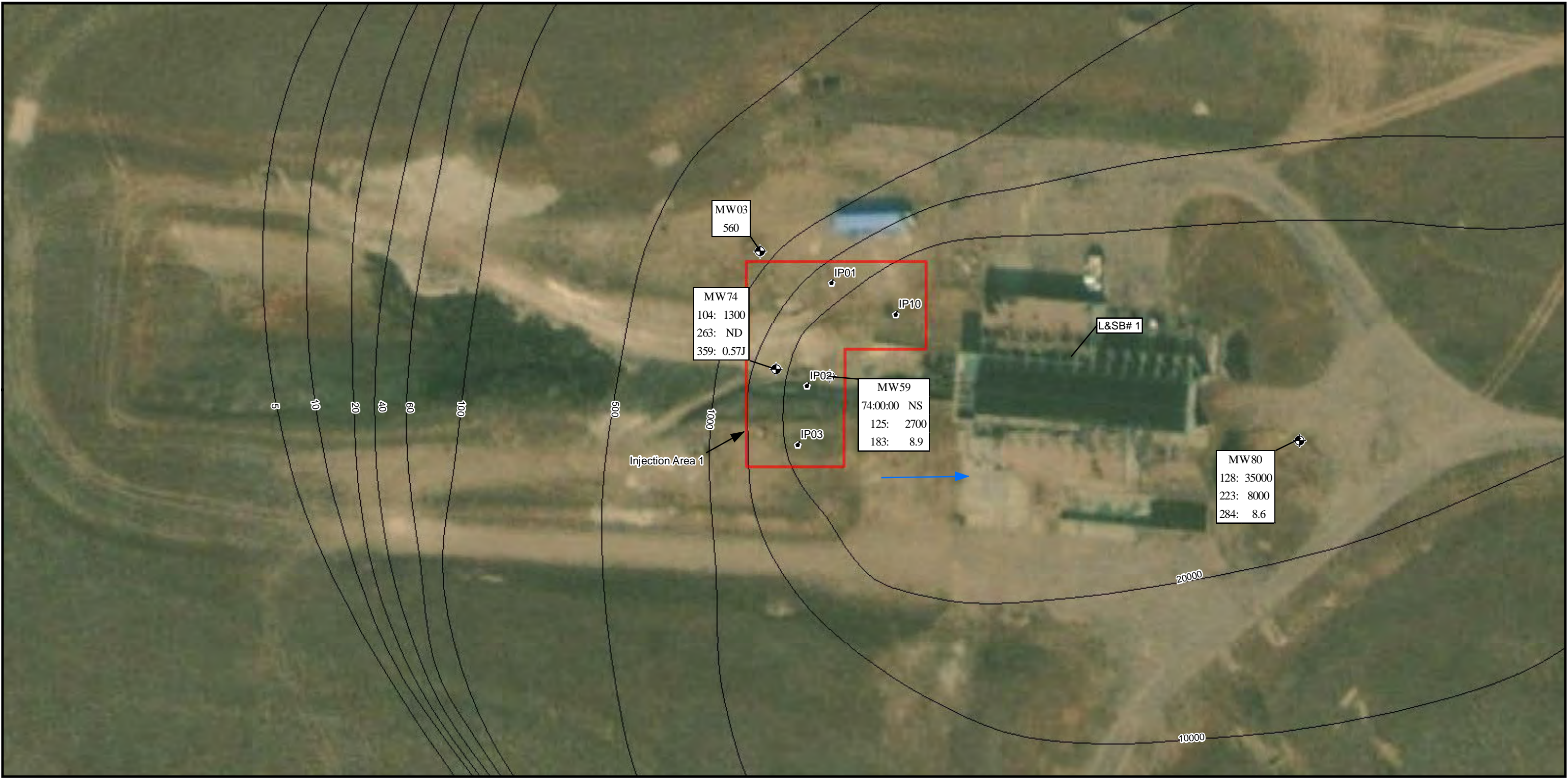
P = performance

PSOD = permanganante soil oxidant demand

TAL = target analyte list

VOC = volatile organic compound

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- Legend**
- Monitoring Well
 - KMnO₄ Injection Point
 - Groundwater Flow Direction
 - Injection Area
 - iso Concentration Line

µg/L = micrograms per liter
J = estimated
KMnO₄ = potassium Permanganate
L&SB = launch and service building
LTM = Long-Term Monitoring
ND = non detect
NS = not sampled
TCE = trichloroethene

Notes:
1) Results shown are TCE concentrations (µg/L) from Fall 2020 LTM/performance monitoring event.
2) Isoconcentrations are based on vertical and horizontal interpretations. Contours may show higher interpreted concentrations than well analytical results if higher concentrations are interpreted to pass over or below the screen interval.

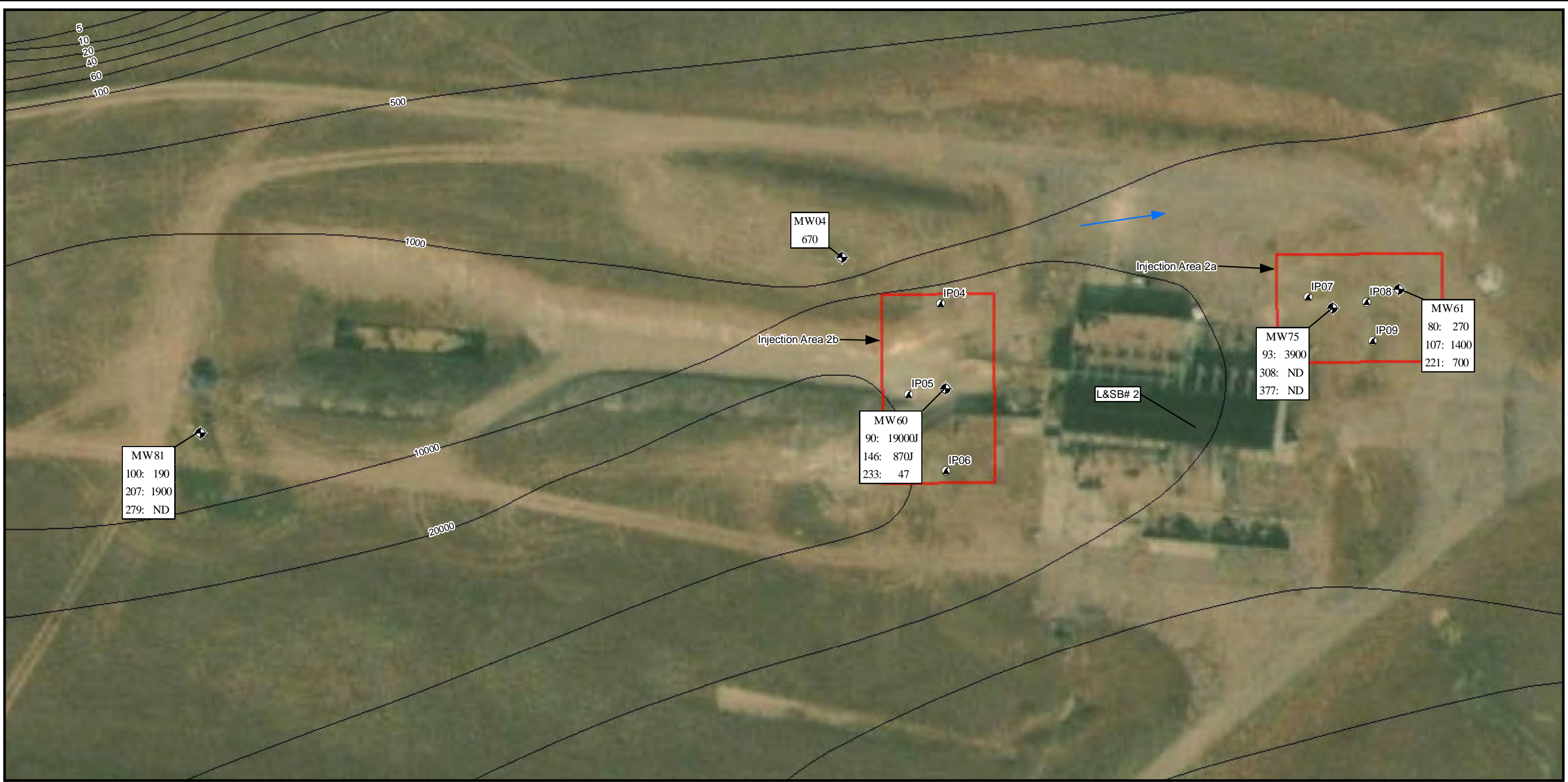
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Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



**KMnO₄ Injection Area
Launch and Service Building #1
Fall 2020 LTM Event 16
Former Atlas "D" Missile Site 4
F.E. Warren Air Force Base, WY**

Drawn By: DPG	Date: 5/21/2021	Project No: 60613342	Figure 2-1
Checked By: IBK	Revision: 0		



- Legend**
- Monitoring Well
 - ZVI Injection Point
 - Groundwater Flow Direction
 - Injection Area
 - isc Concentration Line

µg/L = micrograms per liter
J = estimated
L&SB = launch and service building
LTM = Long-Term Monitoring
ND = non detect
TCE = trichloroethene
ZVI = zero valent iron

Notes:
1) Results shown are TCE concentrations (µg/L) from Fall 2020 LTM/performance monitoring event.
2) Isoconcentrations are based on vertical and horizontal interpretations. Contours may show higher interpreted concentrations than well analytical results if higher concentrations are interpreted to pass over or below the screen interval.

Horizontal Datum:
NAD_1983_StatePlane_Wyoming_East_FIPS_4901_Feet

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



ZVI Injection Areas
Launch and Service Building #2
Fall 2020 LTM Event 16
Former Atlas "D" Missile Site 4
F.E. Warren Air Force Base, WY

Drawn By: DPG	Date: 6/8/2021	Project No: 60613342	Figure 2-2
Checked By: IBK	Revision: 0		

This section includes groundwater analytical results for the baseline and performance monitoring activities completed between May 27 and December 6, 2020 at pilot study areas 1, 2A, and 2B. A total of 40 investigative samples were collected from 8 monitoring wells. Additionally, one field duplicate and two matrix spike/matrix spike duplicates were collected. **Table 2-1** presents a summary of samples collected during performance monitoring activities, including the analyses and sample dates for each well. **Table 3-1** and **Table 3-2** summarize the analytical detections from the KMnO₄ injections and ZVI injections, respectively. Sampling locations and results are shown on **Figure 2-1** and **Figure 2-2** for pilot study areas 1 and 2A/2B, respectively. SCFSs are included in **Appendix A**.

All results above the maximum contaminant level (MCL) or regional screening level (RSL), if no MCL is available, are shaded in the tables. Site-specific chemicals of concern are bold in the tables. Laboratory results including laboratory data packages, data verifications, and data qualifier summaries are provided in the Fall 2020 Long-Term Monitoring Event 16 Report (URS 2021b).

3.1 KMNO₄ INJECTIONS AT L&SB 1 – PILOT STUDY AREA 1

3.1.1 Presence of KMnO₄

KMnO₄ was evident in monitoring well MW59-74 during the September, October, and December 2020 post-injection sampling events. The presence of KMnO₄ at MW59-74 indicates a radius of influence of 15 to 30 feet was achieved during injection. KMnO₄ was present during the last sampling event at MW59-74 indicating the amendment is persisting within the aquifer and has not been exhausted by the natural soil oxidant demand.

3.1.2 Volatile Organic Compounds

Only TCE was detected above its MCL for VOCs in pilot study area 1. TCE trend charts are included in **Table 3-3**. Due to the presence of KMnO₄, only a baseline VOC sample has been collected at MW59-74. The concentration of KMnO₄ was higher than what could be neutralized by ascorbic acid and samples could not be collected to evaluate TCE reductions. However, the continued presence of KMnO₄ indicates TCE concentrations continue to be reduced. TCE concentrations at MW59-125 were reduced from 3000 micrograms per liter (µg/L) (Baseline) to 2,100 µg/L (October 2020) following injection, with a current concentration of 2,700 µg/L (December 2020). TCE concentrations at MW74-104 have increased from 1,100 µg/L (Baseline) to 1,300 µg/L (December 2020) following injection.

3.1.3 Metals

Baseline metals concentrations were all below their respective MCL or RSL screening values for each of the performance monitoring wells. Increasing metals concentrations is evident in MW59-74 due to the presence of KMnO₄. However, no significant increase above MCL/RSL

screening values was observed at MW59-125, and only a slight increase was noted during the first monthly sampling event at MW74-104.

3.1.4 Dissolved Oxygen/Oxygen Reduction Potential

KMnO₄ injections create an aerobic environment or oxidizing conditions within the treatment area. Dissolved oxygen (DO) concentrations greater than 1 milligram per liter (mg/L) indicate aerobic conditions are present. Additionally, positive oxygen-reduction potential (ORP) values indicate oxidizing conditions are present within the aquifer. In general, ORP values measured prior to sample collection have positive values. DO and ORP measurements collected during baseline and performance monitoring events are included in **Table 3-4**.

3.2 ZVI INJECTIONS AT L&SB 2 – PILOT STUDY AREA 2A/2B

3.2.1 Presence of ZVI

ZVI was observed in purge water from MW60-146 on September 1, 2020, MW61-80 on August 20, 2020, and MW61-221 on October 27, 2020 during the Fall 2020 LTM Event 16 sampling. MW61-221 is not a performance monitoring well as it is screened below the targeted injection interval. However, ZVI was observed in purge water during the Fall 2020 LTM Event 16. During pneumatic injection completed at Pilot Study Area 2A, pressures between 5 and 23 psi were noted at MW61-107 during injection at IP08 indicating connection between injections operations and the borehole for the MW61 cluster. Pressures of 5 to 23 psi are not enough to crack or damage the monitoring well casing. However, it was noted during injections that the monitoring wells are constructed with a threaded joint and were not air-tight. ZVI may have entered the MW61-221 casing at these joints and traveled down to the screened area. There is a possibility that during injection the ZVI traveled down the borehole between the bentonite seal and the boring wall or casing for MW61-221. The well construction log for the MW61 cluster indicates a 95-foot bentonite seal between the filter pack for MW61-107 and MW61-221. There is a possibility for gaps within the seal, but this scenario does not seem likely. Additionally, there is a possibility for pneumatic fractures to have reached down to this level during injection. Generally, pneumatic fractures tend to go laterally or towards ground surface, and take the path of least resistance. The ZVI would have a tendency to sink within the formation.

3.2.2 Volatile Organic Compounds

A reduction in TCE concentrations is expected within the treatment areas where pilot study ZVI injections were implemented. Baseline sample results indicated TCE concentrations ranged from 1,300 to 25,000 µg/L in each of the five performance monitoring wells. Changes in TCE concentrations between the Baseline sampling event and the October/November 2020 sampling event completed following injection were as follows:

- **MW61-80:** reduced from 1,300 µg/L to 270 µg/L
- **MW61-107:** reduced from 6,100 µg/L to 1,400 µg/L

- **MW75-93:** steady to increasing with concentrations from 3,500 µg/L (Baseline) to 5,300 µg/L (August 2020), current concentration is 3,900 µg/L
- **MW60-90:** reduced from 25,000 µg/L to 19,000 µg/L
- **MW60-146:** variable with concentrations fluctuating from 2,100 µg/L (Baseline), to 4,900 µg/L (September 2020), to 870 µg/L (October 2020), and 7,500 µg/L (November 2020)

In addition, daughter products of cis-1,2-dichloroethene and vinyl chloride were also detected above their MCLs in all performance monitoring wells except MW75-93. This indicates reductive dechlorination is proceeding.

3.2.3 pH and Oxidation-Reduction Potential

An alkaline pH (pH increase) and negative ORP within the ZVI injection area are indicators that reducing conditions exist in the groundwater. In general, post-injection measurements from monitoring wells within the ZVI treatment area have been steady to increasing for pH levels. ORP measurements were negative during the last performance monitoring event for each well except at MW75-93. pH and ORP measurements collected during baseline and performance monitoring events are included in **Table 3-4**.

3.2.4 Dissolved Oxygen

Low DO (less than 1 mg/L) facilitates reductive treatment in groundwater in the ZVI injection area. DO levels at performance monitoring wells in the ZVI injection area have decreased since injections were completed. However, most performance monitoring wells have DO concentrations greater than 1 mg/L in all but one monitoring well (MW61-107). DO measurements collected during baseline and performance monitoring events are included in **Table 3-4**.

3.2.5 Dissolved Gases

The final degradation products of TCE and its daughter products are the dissolved gases MEE. Therefore, gas generation within the ZVI injection area indicates reactivity with injected ZVI and effective degradation of the chlorinated VOCs. MEE concentrations have slightly increased above baseline concentrations. MEE concentrations are presented in **Table 3-2**.

3.2.6 Chloride

An increase in chloride concentration within the ZVI injection area is expected as a result of dechlorination of TCE and its daughter products. In general, chloride concentrations increased from baseline concentrations following injection. This initial increase in chloride concentrations indicated chlorinated VOCs were being reduced. Chloride concentrations are presented in **Table 3-2**.

3.2.7 Alkalinity and Sulfate

Reductions in alkalinity and sulfate concentrations are expected within the ZVI injection area, indicating highly reducing conditions exist in groundwater. In general, alkalinity concentrations have remained steady between baseline and post-injection samples. Sulfate concentrations have decreased in post-injection samples. Alkalinity and sulfate concentrations are presented in **Table 3-2**.

TABLE 3-1
PILOT STUDY AREA 1 BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW59-74						MW59-74						MW59-74						MW59-74					
FIELD IDENTIFICATION ¹					FEW4-MW59-74-15						FEW4-MW59-74-PS1-1						FEW4-MW59-74-16						FEW4-MW59-74-PS1-3					
DATE COLLECTED					27-May-20						19-Jul-20						25-Sep-20						23-Oct-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	1.4 J	2 / 9	5	--	2500	U	1000	2500	5000	500			NS						NS						NS			
1,2-Dichloroethane	0.39 J	1 / 9	5	--	1500	U	700	1500	5000	500			NS						NS						NS			
2-Butanone (MEK)	15 J	2 / 9	--	5,600	10000	U	3000	10000	50000	500			NS						NS						NS			
2-Hexanone	13 J	1 / 9	--	38	10000	U	4600	10000	50000	500			NS						NS						NS			
Acetone	12 J	1 / 9	--	14,000	10000	U	4750	10000	50000	500			NS						NS						NS			
Chloroform	0.58 J	1 / 9	80 ^d	--	1500	U	350	1500	5000	500			NS						NS						NS			
cis-1,2-Dichloroethene	26	8 / 9	70	--	1500	U	750	1500	5000	500			NS						NS						NS			
Methylene chloride	1.5 J	1 / 9	5	--	5000	U	1750	5000	25000	500			NS						NS						NS			
trans-1,2-Dichloroethene	1.1	1 / 9	100	--	1500	U	750	1500	5000	500			NS						NS						NS			
Trichloroethene (TCE)	190,000	9 / 9	5	--	190000		750	1500	5000	500			NS						NS						NS			
METALS (µg/L)																												
Aluminum	41,900	12 / 12	--	20,000			NS				3770		5.00	10.0	20.0	1	22600		5.00	10.0	20.0	1	4900		5.00	10.0	20.0	1
Antimony	6 1	12 / 12	6	--			NS				0.540	J	0.350	1.00	6.00	1	1.00	U	0.350	1.00	6.00	1	1.00	U	0.350	1.00	6.00	1
Arsenic	8.1	12 / 12	10	--			NS				2.70	J	0.310	1.00	5.00	1	5.00	U	0.310	1.00	5.00	1	0.360	J	0.310	1.00	5.00	1
Barium	7,830	12 / 12	2,000	--			NS				190		0.250	0.800	3.00	1	7830		0.250	0.800	3.00	1	7250		0.250	0.800	3.00	1
Beryllium	2.6	12 / 12	4	--			NS				0.200	U	0.0800	0.200	1.00	1	0.940	J	0.0800	0.200	1.00	1	0.620	J	0.0800	0.200	1.00	1
Cadmium	1 1	12 / 12	5	--			NS				0.0650	J	0.0500	0.100	1.00	1	1.00	U	0.0500	0.100	1.00	1	0.140	J	0.0500	0.100	1.00	1
Calcium	1,120,000	12 / 12	--	--			NS				65200		60.0	150	200	1	1120000		60.0	150	200	1	622000		60.0	150	200	1
Chromium	142	12 / 12	100	--			NS				21.4		0.450	1.50	10.0	1	142		0.450	1.50	10.0	1	30.4		0.450	1.50	10.0	1
Cobalt	7.9	12 / 12	--	6			NS				0.970	J	0.130	0.400	1.00	1	3.10		0.130	0.400	1.00	1	0.400	U	0.130	0.400	1.00	1
Copper	20.6	12 / 12	1,300	--			NS				3.40		0.550	1.50	2.00	1	10.0		0.550	1.50	2.00	1	0.710	J	0.550	1.50	2.00	1
Iron	23700	12 / 12	--	14,000			NS				2700		13.6	30.0	40.0	1	10700		13.6	30.0	40.0	1	183		13.6	30.0	40.0	1
Lead	19.4	12 / 12	15	--			NS				1.80	J	0.190	0.400	3.00	1	3.80		0.190	0.400	3.00	1	0.400	U	0.190	0.400	3.00	1
Magnesium	167,000	12 / 12	--	--			NS				10600		6.10	20.0	40.0	1	167000		6.10	20.0	40.0	1	92000		6.10	20.0	40.0	1
Manganese	4,570,000	12 / 12	--	430			NS				43.8		0.300	0.800	3.50	1	4570000		0.300	0.800	3.50	1	2080000		0.3	0.8	3.5	63
Nickel	26.8	12 / 12	--	390			NS				13.5		0.300	0.800	3.00	1	7.10		0.300	0.800	3.00	1	1.90	J	0.300	0.800	3.00	1
Potassium	1,490,000	12 / 12	--	--			NS				3050		20.0	40.0	50.0	1	1490000		20.0	40.0	50.0	1	621000		20.0	40.0	50.0	1
Selenium	5 1	12 / 12	50	--			NS				0.690	J	0.500	2.00	5.00	1	5.00	U	0.500	2.00	5.00	1	1.10	J	0.500	2.00	5.00	1
Silver	1 1	12 / 12	--	94			NS				0.100	U	0.0300	0.100	1.00	1	1.00	U	0.0300	0.100	1.00	1	0.130	J	0.0300	0.100	1.00	1
Sodium	35,300 J	12 / 12	--	--			NS				9300		25.0	50.0	100	1	35300	J	25.0	50.0	100	1	28800		25.0	50.0	100	1
Thallium	2.2 J	12 / 12	2	--			NS				0.110	J	0.100	0.200	1.00	1	1.00	U	0.100	0.200	1.00	1	0.130	J	0.100	0.200	1.00	1
Vanadium	110	12 / 12	--	86			NS				14.4		0.450	1.00	6.00	1	6.00	U	0.450	1.00	6.00	1	1.00	U	0.450	1.00	6.00	1
Zinc	86.5	12 / 12	--	6,000			NS				9.30	J	7.50	15.0	20.0	1	40.8		7.50	15.0	20.0	1	19.4	J	7.50	15.0	20.0	1
Mercury	1 1	12 / 12	2	--			NS				0.150	U	0.0600	0.150	0.200	1	1.00		0.0600	0.150	0.200	1	0.720		0.0600	0.150	0.200	1
Chromium, Hexavalent	0.2 UJ	5 / 5	--	0.035			NS				0.200	UJ	0.0900	0.200	0.500	1			NS						NS			

Notes:

Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSL.

Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);

Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

Pilot Study Baseline/Monthly Post-Injection PM Report

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

-- = No MCL or RSL designated

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

NS = not sampled

Qual = qualifier

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 3-1
PILOT STUDY AREA 1 BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW59-74						MW59-125						MW59-125						MW59-125					
FIELD IDENTIFICATION ¹					FEW4-MW59-74-PS1-4						FEW4-MW59-125-15						FEW4-MW59-125-PS1-1						FEW4-MW59-125-16					
DATE COLLECTED					02-Dec-20						28-Jun-20						19-Jul-20						28-Sep-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	1.4 J	2 / 9	5	--			NS				1.00	U	0.400	1.00	2.00	2			NS				1.40	J	0.400	1.00	2.00	2
1,2-Dichloroethane	0.39 J	1 / 9	5	--			NS				0.600	U	0.280	0.600	2.00	2			NS				0.390	J	0.280	0.600	2.00	2
2-Butanone (MEK)	15 J	2 / 9	--	5,600			NS				4.00	U	1.20	4.00	20.0	2			NS				2.60	J	1.20	4.00	20.0	2
2-Hexanone	13 J	1 / 9	--	38			NS				4.00	U	1.84	4.00	20.0	2			NS				13.0	J	1.84	4.00	20.0	2
Acetone	12 J	1 / 9	--	14,000			NS				4.00	U	1.90	4.00	20.0	2			NS				4.00	U	1.90	4.00	20.0	2
Chloroform	0.58 J	1 / 9	80 ^d	--			NS				0.600	U	0.140	0.600	2.00	2			NS				0.580	J	0.140	0.600	2.00	2
cis-1,2-Dichloroethene	26	8 / 9	70	--			NS				24.0		0.300	0.600	2.00	2			NS				25.0		0.300	0.600	2.00	2
Methylene chloride	1.5 J	1 / 9	5	--			NS				2.00	U	0.700	2.00	10.0	2			NS				2.00	U	0.700	2.00	10.0	2
trans-1,2-Dichloroethene	1.1	1 / 9	100	--			NS				0.600	U	0.300	0.600	2.00	2			NS				0.600	U	0.300	0.600	2.00	2
Trichloroethene (TCE)	190,000	9 / 9	5	--			NS				3000		7.50	15.0	50.0	50			NS				2900		15.0	30.0	100	100
METALS (µg/L)																												
Aluminum	41,900	12 / 12	--	20,000	41900		5.00	10.0	20.0	1			NS				80.0		5.00	10.0	20.0	1	272		5.00	10.0	20.0	1
Antimony	6 1	12 / 12	6	--	1.00	U	0.350	1.00	6.00	1			NS				0.690	J	0.350	1.00	6.00	1	1.00	U	0.350	1.00	6.00	1
Arsenic	8.1	12 / 12	10	--	5.30		0.310	1.00	5.00	1			NS				1.90	J	0.310	1.00	5.00	1	2.8	J	0.310	1.00	5.00	1
Barium	7,830	12 / 12	2,000	--	6640		0.250	0.800	3.00	1			NS				123		0.250	0.800	3.00	1	158		0.250	0.800	3.00	1
Beryllium	2.6	12 / 12	4	--	1.60		0.0800	0.200	1.00	1			NS				0.200	U	0.0800	0.200	1.00	1	0.200	U	0.0800	0.200	1.00	1
Cadmium	1 1	12 / 12	5	--	0.280	J	0.0500	0.100	1.00	1			NS				0.100	U	0.0500	0.100	1.00	1	0.100	U	0.0500	0.100	1.00	1
Calcium	1,120,000	12 / 12	--	--	442000		60.0	150	200	1			NS				48300		60.0	150	200	1	52200		60.0	150	200	1
Chromium	142	12 / 12	100	--	134		0.450	1.50	10.0	1			NS				1.90	J	0.450	1.50	10.0	1	2.30	J	0.450	1.50	10.0	1
Cobalt	7.9	12 / 12	--	6	6.30		0.130	0.400	1.00	1			NS				0.400	U	0.130	0.400	1.00	1	0.320	J	0.130	0.400	1.00	1
Copper	20.6	12 / 12	1,300	--	20.6		0.550	1.50	2.00	1			NS				0.600	J	0.550	1.50	2.00	1	1.2	J	0.550	1.50	2.00	1
Iron	23700	12 / 12	--	14,000	23700		13.6	30.0	40.0	1			NS				79.9		13.6	30.0	40.0	1	190		13.6	30.0	40.0	1
Lead	19.4	12 / 12	15	--	17.3		0.190	0.400	3.00	1			NS				0.400	U	0.190	0.400	3.00	1	0.9	J	0.190	0.400	3.00	1
Magnesium	167,000	12 / 12	--	--	66500		6.10	20.0	40.0	1			NS				7870		6.10	20.0	40.0	1	8580		6.10	20.0	40.0	1
Manganese	4,570,000	12 / 12	--	430	1090000		60.0	160	700	200			NS				28.6		0.300	0.800	3.50	1	79.3		0.300	0.800	3.50	1
Nickel	26.8	12 / 12	--	390	13.2		0.300	0.800	3.00	1			NS				1.40	J	0.300	0.800	3.00	1	1.60	J	0.300	0.800	3.00	1
Potassium	1,490,000	12 / 12	--	--	301000		20.0	40.0	50.0	1			NS				3690		20.0	40.0	50.0	1	4150		20.0	40.0	50.0	1
Selenium	5 1	12 / 12	50	--	4.80	J	0.500	2.00	5.00	1			NS				0.980	J	0.500	2.00	5.00	1	2.00	U	0.500	2.00	5.00	1
Silver	1 1	12 / 12	--	94	0.630	J	0.0300	0.100	1.00	1			NS				0.100	U	0.0300	0.100	1.00	1	0.064	J	0.0300	0.100	1.00	1
Sodium	35,300 J	12 / 12	--	--	24500		25.0	50.0	100	1			NS				10300		25.0	50.0	100	1	10900		25.0	50.0	100	1
Thallium	2.2 J	12 / 12	2	--	0.510	J	0.100	0.200	1.00	1			NS				0.200	U	0.100	0.200	1.00	1	1.20		0.100	0.200	1.00	1
Vanadium	110	12 / 12	--	86	110		0.450	1.00	6.00	1			NS				5.40	J	0.450	1.00	6.00	1	7.90		0.450	1.00	6.00	1
Zinc	86.5	12 / 12	--	6,000	86.5		7.50	15.0	20.0	1			NS				15.0	U	7.50	15.0	20.0	1	15.0	U	7.50	15.0	20.0	1
Mercury	1 1	12 / 12	2	--	0.570		0.0600	0.150	0.200	1			NS				0.150	U	0.0600	0.150	0.200	1	0.150	U	0.0600	0.150	0.200	1
Chromium, Hexavalent	0.2 UJ	5 / 5	--	0.035			NS						NS				0.200	UJ	0.0900	0.200	0.500	1	0.170	J	0.0900	0.200	0.500	1

Notes:

Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI-- = No MCL or RSL designated

Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);

Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

Pilot Study Baseline/Monthly Post-Injection PM Report

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

Qual = qualifier

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 3-1
PILOT STUDY AREA 1 BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW59-125						MW59-125						MW74-104						MW74-104					
FIELD IDENTIFICATION ¹					FEW4-MW59-125-PS1-3						FEW4-MW59-125-PS1-4						FEW4-MW74-104-15						FEW4-MW74-104-PS1-1					
DATE COLLECTED					23-Oct-20						06-Dec-20						26-Jun-20						19-Jul-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	1.4 J	2 / 9	5	--	0.500	U	0.200	0.500	1.00	1	2.00	U	0.800	2.00	4.00	4	1.00	U	0.400	1.00	2.00	2			NS			
1,2-Dichloroethane	0.39 J	1 / 9	5	--	0.300	U	0.140	0.300	1.00	1	1.20	U	0.560	1.20	4.00	4	0.600	U	0.280	0.600	2.00	2			NS			
2-Butanone (MEK)	15 J	2 / 9	--	5,600	2.00	U	0.600	2.00	10.0	1	8.00	U	2.40	8.00	40.0	4	4.00	U	1.20	4.00	20.0	2			NS			
2-Hexanone	13 J	1 / 9	--	38	2.00	U	0.920	2.00	10.0	1	8.00	U	3.68	8.00	40.0	4	4.00	U	1.84	4.00	20.0	2			NS			
Acetone	12 J	1 / 9	--	14,000	2.00	U	0.950	2.00	10.0	1	8.00	U	3.80	8.00	40.0	4	4.00	U	1.90	4.00	20.0	2			NS			
Chloroform	0.58 J	1 / 9	80 ^d	--	0.300	U	0.0700	0.300	1.00	1	1.20	U	0.280	1.20	4.00	4	0.600	U	0.140	0.600	2.00	2			NS			
cis-1,2-Dichloroethene	26	8 / 9	70	--	26.0		0.150	0.300	1.00	1	24.0		0.600	1.20	4.00	4	10.0		0.300	0.600	2.00	2			NS			
Methylene chloride	1.5 J	1 / 9	5	--	1.00	U	0.350	1.00	5.00	1	4.00	U	1.40	4.00	20.0	4	2.00	U	0.700	2.00	10.0	2			NS			
trans-1,2-Dichloroethene	1.1	1 / 9	100	--	1.10		0.150	0.300	1.00	1	1.20	U	0.600	1.20	4.00	4	0.600	U	0.300	0.600	2.00	2			NS			
Trichloroethene (TCE)	190,000	9 / 9	5	--	2100	J	15.0	30.0	100	100	2700		15.0	30.0	100	100	1100		3.00	6.00	20.0	20			NS			
METALS (µg/L)																												
Aluminum	41,900	12 / 12	--	20,000	288		5.00	10.0	20.0	1	336		5.00	10.0	20.0	1			NS				102		5.00	10.0	20.0	1
Antimony	6 1	12 / 12	6	--	1.00	U	0.350	1.00	6.00	1	1.00	U	0.350	1.00	6.00	1			NS				1.00	U	0.350	1.00	6.00	1
Arsenic	8.1	12 / 12	10	--	2.60	J	0.310	1.00	5.00	1	2.50	J	0.310	1.00	5.00	1			NS				2.70	J	0.310	1.00	5.00	1
Barium	7,830	12 / 12	2,000	--	167		0.250	0.800	3.00	1	149		0.250	0.800	3.00	1			NS				136		0.250	0.800	3.00	1
Beryllium	2.6	12 / 12	4	--	0.200	U	0.0800	0.200	1.00	1	0.200	U	0.0800	0.200	1.00	1			NS				0.200	U	0.0800	0.200	1.00	1
Cadmium	1 1	12 / 12	5	--	0.100	U	0.0500	0.100	1.00	1	0.100	U	0.0500	0.100	1.00	1			NS				0.100	U	0.0500	0.100	1.00	1
Calcium	1,120,000	12 / 12	--	--	56600		60.0	150	200	1	51900		60.0	150	200	1			NS				58800		60.0	150	200	1
Chromium	142	12 / 12	100	--	2.80	J	0.450	1.50	10.0	1	3.50	J	0.450	1.50	10.0	1			NS				1.60	J	0.450	1.50	10.0	1
Cobalt	7.9	12 / 12	--	6	0.250	J	0.130	0.400	1.00	1	0.290	J	0.130	0.400	1.00	1			NS				0.270	J	0.130	0.400	1.00	1
Copper	20.6	12 / 12	1,300	--	0.560	J	0.550	1.50	2.00	1	0.560	J	0.550	1.50	2.00	1			NS				0.710	J	0.550	1.50	2.00	1
Iron	23700	12 / 12	--	14,000	232		13.6	30.0	40.0	1	241	J	13.6	30.0	40.0	1			NS				91.8		13.6	30.0	40.0	1
Lead	19.4	12 / 12	15	--	0.400	U	0.190	0.400	3.00	1	0.250	J	0.190	0.400	3.00	1			NS				0.400	U	0.190	0.400	3.00	1
Magnesium	167,000	12 / 12	--	--	9840		6.10	20.0	40.0	1	8920		6.10	20.0	40.0	1			NS				9400		6.10	20.0	40.0	1
Manganese	4,570,000	12 / 12	--	430	60.6		0.300	0.800	3.50	1	62.9		0.300	0.800	3.50	1			NS				300		0.300	0.800	3.50	1
Nickel	26.8	12 / 12	--	390	2.20	J	0.300	0.800	3.00	1	2.20	J	0.300	0.800	3.00	1			NS				1.20	J	0.300	0.800	3.00	1
Potassium	1,490,000	12 / 12	--	--	4490		20.0	40.0	50.0	1	4180		20.0	40.0	50.0	1			NS				3810		20.0	40.0	50.0	1
Selenium	5 1	12 / 12	50	--	2.00	U	0.500	2.00	5.00	1	0.550	J	0.500	2.00	5.00	1			NS				2.00	U	0.500	2.00	5.00	1
Silver	1 1	12 / 12	--	94	0.100	U	0.0300	0.100	1.00	1	0.100	U	0.0300	0.100	1.00	1			NS				0.100	U	0.0300	0.100	1.00	1
Sodium	35,300 J	12 / 12	--	--	12300		25.0	50.0	100	1	11600		25.0	50.0	100	1			NS				13900		25.0	50.0	100	1
Thallium	2.2 J	12 / 12	2	--	0.270	J	0.100	0.200	1.00	1	0.460	J	0.100	0.200	1.00	1			NS				0.200	U	0.100	0.200	1.00	1
Vanadium	110	12 / 12	--	86	9.60		0.450	1.00	6.00	1	12.7	J	0.450	1.00	6.00	1			NS				3.50	J	0.450	1.00	6.00	1
Zinc	86.5	12 / 12	--	6,000	15.0	U	7.50	15.0	20.0	1	15.0	U	7.50	15.0	20.0	1			NS				15.0	U	7.50	15.0	20.0	1
Mercury	1 1	12 / 12	2	--	0.150	U	0.0600	0.150	0.200	1	0.150	U	0.0600	0.150	0.200	1			NS				0.150	U	0.0600	0.150	0.200	1
Chromium, Hexavalent	0.2 UJ	5 / 5	--	0.035			NS						NS						NS				0.200	UJ	0.0900	0.200	0.500	1

Notes:

Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI-- = No MCL or RSL designated

Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);

Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

Pilot Study Baseline/Monthly Post-Injection PM Report

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

Qual = qualifier

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 3-1
PILOT STUDY AREA 1 BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW74-104						MW74-104						MW74-104					
FIELD IDENTIFICATION ¹					FEW4-MW74-104-16						FEW4-MW74-104-PS1-3						FEW4-MW74-104-PS1-4					
DATE COLLECTED					24-Sep-20						22-Oct-20						05-Dec-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																						
1,1,2-Trichloroethane	1.4 J	2 / 9	5	--	1.10	J	0.400	1.00	2.00	2	0.500	U	0.200	0.500	1.00	1	1.00	U	0.400	1.00	2.00	2
1,2-Dichloroethane	0.39 J	1 / 9	5	--	0.600	U	0.280	0.600	2.00	2	0.300	U	0.140	0.300	1.00	1	0.600	U	0.280	0.600	2.00	2
2-Butanone (MEK)	15 J	2 / 9	--	5,600	15.0	J	1.20	4.00	20.0	2	2.00	U	0.600	2.00	10.0	1	4.00	U	1.20	4.00	20.0	2
2-Hexanone	13 J	1 / 9	--	38	4.00	U	1.84	4.00	20.0	2	2.00	U	0.920	2.00	10.0	1	4.00	U	1.84	4.00	20.0	2
Acetone	12 J	1 / 9	--	14,000	12.0	J	1.90	4.00	20.0	2	2.00	U	0.950	2.00	10.0	1	4.00	U	1.90	4.00	20.0	2
Chloroform	0.58 J	1 / 9	80 ^d	--	0.600	U	0.140	0.600	2.00	2	0.300	U	0.0700	0.300	1.00	1	0.600	U	0.140	0.600	2.00	2
cis-1,2-Dichloroethene	26	8 / 9	70	--	11.0		0.300	0.600	2.00	2	14.0		0.150	0.300	1.00	1	14.0		0.300	0.600	2.00	2
Methylene chloride	1.5 J	1 / 9	5	--	2.00	U	0.700	2.00	10.0	2	1.50	J	0.350	1.00	5.00	1	2.00	U	0.700	2.00	10.0	2
trans-1,2-Dichloroethene	1.1	1 / 9	100	--	0.600	U	0.300	0.600	2.00	2	0.300	U	0.150	0.300	1.00	1	0.600	U	0.300	0.600	2.00	2
Trichloroethene (TCE)	190,000	9 / 9	5	--	1000		3.00	6.00	20.0	20	1100	J	3.00	6.00	20.0	20	1300		7.50	15.0	50.0	50
METALS (µg/L)																						
Aluminum	41,900	12 / 12	--	20,000	36700		5.00	10.0	20.0	1	10400		5.00	10.0	20.0	1	463		5.00	10.0	20.0	1
Antimony	6 1	12 / 12	6	--	6.00	U	0.350	1.00	6.00	1	1.00	U	0.350	1.00	6.00	1	1.00	U	0.350	1.00	6.00	1
Arsenic	8.1	12 / 12	10	--	8.10		0.310	1.00	5.00	1	5.60		0.310	1.00	5.00	1	3.10	J	0.310	1.00	5.00	1
Barium	7,830	12 / 12	2,000	--	393		0.250	0.800	3.00	1	269		0.250	0.800	3.00	1	156		0.250	0.800	3.00	1
Beryllium	2.6	12 / 12	4	--	2.60		0.0800	0.200	1.00	1	0.940	J	0.0800	0.200	1.00	1	0.200	U	0.0800	0.200	1.00	1
Cadmium	1 1	12 / 12	5	--	1.00	U	0.0500	0.100	1.00	1	0.0680	J	0.0500	0.100	1.00	1	0.100	U	0.0500	0.100	1.00	1
Calcium	1,120,000	12 / 12	--	--	85600		60.0	150	200	1	76400		60.0	150	200	1	57000		60.0	150	200	1
Chromium	142	12 / 12	100	--	38.6		0.450	1.50	10.0	1	6.50	J	0.450	1.50	10.0	1	0.630	J	0.450	1.50	10.0	1
Cobalt	7.9	12 / 12	--	6	7.90		0.130	0.400	1.00	1	3.60		0.130	0.400	1.00	1	0.540	J	0.130	0.400	1.00	1
Copper	20.6	12 / 12	1,300	--	12.7		0.550	1.50	2.00	1	6.40		0.550	1.50	2.00	1	0.990	J	0.550	1.50	2.00	1
Iron	23700	12 / 12	--	14,000	16500		13.6	30.0	40.0	1	6370		13.6	30.0	40.0	1	302	J	13.6	30.0	40.0	1
Lead	19.4	12 / 12	15	--	19.4		0.190	0.400	3.00	1	7.80		0.190	0.400	3.00	1	0.260	J	0.190	0.400	3.00	1
Magnesium	167,000	12 / 12	--	--	23300		6.10	20.0	40.0	1	15300		6.10	20.0	40.0	1	9270		6.10	20.0	40.0	1
Manganese	4,570,000	12 / 12	--	430	1230		0.300	0.800	3.50	1	593		0.300	0.800	3.50	1	381		0.300	0.800	3.50	1
Nickel	26.8	12 / 12	--	390	26.8		0.300	0.800	3.00	1	5.00		0.300	0.800	3.00	1	0.710	J	0.300	0.800	3.00	1
Potassium	1,490,000	12 / 12	--	--	8960		20.0	40.0	50.0	1	5970		20.0	40.0	50.0	1	3960		20.0	40.0	50.0	1
Selenium	5 1	12 / 12	50	--	5.00	U	0.500	2.00	5.00	1	2.00	U	0.500	2.00	5.00	1	2.00	U	0.500	2.00	5.00	1
Silver	1 1	12 / 12	--	94	1.00	U	0.0300	0.100	1.00	1	0.0310	J	0.0300	0.100	1.00	1	0.100	U	0.0300	0.100	1.00	1
Sodium	35,300 J	12 / 12	--	--	18200	J	25.0	50.0	100	1	16900		25.0	50.0	100	1	16700		25.0	50.0	100	1
Thallium	2.2 J	12 / 12	2	--	2.20	J	0.100	0.200	1.00	1	0.120	J	0.100	0.200	1.00	1	0.140	J	0.100	0.200	1.00	1
Vanadium	110	12 / 12	--	86	47.1		0.450	1.00	6.00	1	18.3		0.450	1.00	6.00	1	9.60	J	0.450	1.00	6.00	1
Zinc	86.5	12 / 12	--	6,000	68.4		7.50	15.0	20.0	1	30.8		7.50	15.0	20.0	1	69.4		7.50	15.0	20.0	1
Mercury	1 1	12 / 12	2	--	0.150	U	0.0600	0.150	0.200	1	0.150	U	0.0600	0.150	0.200	1	0.150	U	0.0600	0.150	0.200	1
Chromium, Hexavalent	0.2 UJ	5 / 5	--	0.035	0.100	J	0.0900	0.200	0.500	1			NS						NS			

Notes:

Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI-- = No MCL or RSL designated

Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);
Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

Qual = qualifier

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 3-2
PILOT STUDY AREA 2A/2B BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW61-80						MW61-80						MW61-80						MW61-80					
FIELD IDENTIFICATION ¹					FEW4-MW61-80-15						FEW4-MW61-80-PS2A-1						FEW4-MW61-80-PS2A-2						FEW4-MW61-80-PS2A-3					
DATE COLLECTED					27-Jun-20						09-Jul-20						20-Aug-20						17-Sep-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	5.9	8 / 19	5	--	0.500	U	0.200	0.500	1.00	1			NS				0.290	J	0.200	0.500	1.00	1	0.400	J	0.400	1.00	2.00	2
1,1-Dichloroethene	5.5	2 / 19	7	--	0.500	U	0.250	0.500	1.00	1			NS				0.500	UJ	0.250	0.500	1.00	1	1.00	UJ	0.500	1.00	2.00	2
2-Butanone (MEK)	35 J	6 / 19	--	5600	2.00	U	0.600	2.00	10.0	1			NS				26.0	J	0.600	2.00	10.0	1	28.0		1.20	4.00	20.0	2
2-Hexanone	5.9 J	1 / 19	--	38	2.00	U	0.920	2.00	10.0	1			NS				2.00	UJ	0.920	2.00	10.0	1	4.00	U	1.84	4.00	20.0	2
Acetone	1300 J	6 / 19	--	14000	2.00	U	0.950	2.00	10.0	1			NS				130	J	0.950	2.00	10.0	1	11.0	J	1.90	4.00	20.0	2
Benzene	0.69 J	2 / 19	5	--	0.300	U	0.150	0.300	1.00	1			NS				0.690	J	0.150	0.300	1.00	1	0.600	U	0.300	0.600	2.00	2
Carbon disulfide	0.96 J	1 / 19	--	810	0.500	U	0.200	0.500	1.00	1			NS				0.500	UJ	0.200	0.500	1.00	1	1.00	U	0.400	1.00	2.00	2
Chloroform	2.1 J	5 / 19	80 ^d	--	0.300	U	0.0700	0.300	1.00	1			NS				0.300	UJ	0.0700	0.300	1.00	1	0.600	U	0.140	0.600	2.00	2
Chloromethane	1.2 J	1 / 19	--	190	0.500	U	0.250	0.500	1.00	1			NS				0.500	UJ	0.250	0.500	1.00	1	1.00	U	0.500	1.00	2.00	2
cis-1,2-Dichloroethene	3000	18 / 19	70	--	4.30		0.150	0.300	1.00	1			NS				3.70	J	0.150	0.300	1.00	1	120		0.300	0.600	2.00	2
Toluene	0.45 J	2 / 19	1000	--	0.300	U	0.150	0.300	1.00	1			NS				0.450	J	0.150	0.300	1.00	1	0.600	U	0.300	0.600	2.00	2
trans-1,2-Dichloroethene	4.9 J	2 / 19	100	--	0.300	U	0.150	0.300	1.00	1			NS				0.230	J	0.150	0.300	1.00	1	0.600	U	0.300	0.600	2.00	2
Trichloroethene (TCE)	25000 J	19 / 19	5	--	1300		3.00	6.00	20.0	20			NS				250	J	1.50	3.00	10.0	10	320		1.50	3.00	10.0	10
Vinyl chloride	7.8 J	4 / 19	2	--	0.300	U	0.150	0.300	1.00	1			NS				0.300	UJ	0.150	0.300	1.00	1	1.00	J	0.300	0.600	2.00	2
DISSOLVED GAS (µg/L)																												
Ethane	160	12 / 20	--	--			NS				1.70	U	0.510	1.70	5.00	1	16.0		0.510	1.70	5.00	1	32.0		0.510	1.70	5.00	1
Ethene	11	8 / 20	--	--			NS				1.80	U	0.470	1.80	5.00	1	1.80	U	0.470	1.80	5.00	1	8.80		0.470	1.80	5.00	1
Methane	480	11 / 20	--	--			NS				1.00	U	0.250	1.00	5.00	1	9.50		0.250	1.00	5.00	1	49.0		0.250	1.00	5.00	1
ANIONS (mg/L)																												
Chloride	32.2	20 / 20	--	--			NS				2.70		0.0800	0.200	1.00	1	32.2		0.0800	0.200	1.00	1	9.00		0.0800	0.200	1.00	1
Sulfate	10.7	20 / 20	--	--			NS				9.00		0.0900	0.198	1.00	1	3.50		0.0900	0.198	1.00	1	3.60		0.0900	0.198	1.00	1
ALKALINITY (mg/L)																												
Alkalinity, Bicarbonate (as CaCO3)	346	20 / 20	--	--			NS				165		0.850	1.70	2.00	1	346		0.850	1.70	2.00	1	197		0.850	1.70	2.00	1
Alkalinity, Carbonate (as CaCO3)	ND	0 / 20	--	--			NS				1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1
Alkalinity, Total (as CaCO3)	346	20 / 20	--	--			NS				165		0.850	1.70	2.00	1	346		0.850	1.70	2.00	1	197		0.850	1.70	2.00	1

Notes:
Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSL.
Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.
^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)
^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);
Cancer Risk = 1E-06, Hazard Quotient = 1.0
^d As trihalomethanes
-- = No MCL or RSL designated
µg/L = micrograms per liter
DF = dilution factor
J = estimated
LOD = limit of detection
LOQ = limit of quantitation
MCL = maximum contaminant level
MDL = method detection limit
RSL = regional screening level
U = nondetect
UJ = estimated nondetect
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

TABLE 3-2
PILOT STUDY AREA 2A/2B BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW61-80						MW61-107						MW61-107						MW61-107					
FIELD IDENTIFICATION ¹					FEW4-MW61-80-16						FEW4-MW61-107-15						FEW4-MW61-107-PS2A-1						FEW4-MW61-107-PS2A-2					
DATE COLLECTED					20-Oct-20						27-Jun-20						09-Jul-20						20-Aug-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	5.9	8 / 19	5	--	0.360	J	0.200	0.500	1.00	1	12.5	U	5.00	12.5	25.0	25			NS				2.00	UJ	0.800	2.00	4.00	4
1,1-Dichloroethene	5.5	2 / 19	7	--	0.590	J	0.250	0.500	1.00	1	12.5	U	6.25	12.5	25.0	25			NS				2.00	UJ	1.00	2.00	4.00	4
2-Butanone (MEK)	35 J	6 / 19	--	5600	13.0		0.600	2.00	10.0	1	50.0	U	15.0	50.0	250	25			NS				8.00	UJ	2.40	8.00	40.0	4
2-Hexanone	5.9 J	1 / 19	--	38	2.00	U	0.920	2.00	10.0	1	50.0	U	23.0	50.0	250	25			NS				8.00	UJ	3.68	8.00	40.0	4
Acetone	1300 J	6 / 19	--	14000	1.60	J	0.950	2.00	10.0	1	50.0	U	23.8	50.0	250	25			NS				8.00	UJ	3.80	8.00	40.0	4
Benzene	0.69 J	2 / 19	5	--	0.160	J	0.150	0.300	1.00	1	7.50	U	3.75	7.50	25.0	25			NS				1.20	UJ	0.600	1.20	4.00	4
Carbon disulfide	0.96 J	1 / 19	--	810	0.960	J	0.200	0.500	1.00	1	12.5	U	5.00	12.5	25.0	25			NS				2.00	UJ	0.800	2.00	4.00	4
Chloroform	2.1 J	5 / 19	80 ^d	--	0.180	J	0.0700	0.300	1.00	1	7.50	U	1.75	7.50	25.0	25			NS				0.830	J	0.280	1.20	4.00	4
Chloromethane	1.2 J	1 / 19	--	190	0.500	U	0.250	0.500	1.00	1	12.5	U	6.25	12.5	25.0	25			NS				2.00	UJ	1.00	2.00	4.00	4
cis-1,2-Dichloroethene	3000	18 / 19	70	--	210		1.50	3.00	10.0	10	7.50	U	3.75	7.50	25.0	25			NS				2600		15.0	30.0	100	100
Toluene	0.45 J	2 / 19	1000	--	0.150	J	0.150	0.300	1.00	1	7.50	U	3.75	7.50	25.0	25			NS				1.20	UJ	0.600	1.20	4.00	4
trans-1,2-Dichloroethene	4.9 J	2 / 19	100	--	0.300	U	0.150	0.300	1.00	1	7.50	U	3.75	7.50	25.0	25			NS				4.90	J	0.600	1.20	4.00	4
Trichloroethene (TCE)	25000 J	19 / 19	5	--	270		1.50	3.00	10.0	10	6100		3.75	7.50	25.0	25			NS				1800		15.0	30.0	100	100
Vinyl chloride	7.8 J	4 / 19	2	--	1.40		0.150	0.300	1.00	1	7.50	U	3.75	7.50	25.0	25			NS				1.20	UJ	0.600	1.20	2.00	4
DISSOLVED GAS (µg/L)																												
Ethane	160	12 / 20	--	--	31.0		0.510	1.70	5.00	1			NS				1.70	U	0.510	1.70	5.00	1	75.0		0.510	1.70	5.00	1
Ethene	11	8 / 20	--	--	11.0		0.470	1.80	5.00	1			NS				1.80	U	0.470	1.80	5.00	1	1.80	U	0.470	1.80	5.00	1
Methane	480	11 / 20	--	--	480		0.250	1.00	5.00	1			NS				1.00	U	0.250	1.00	5.00	1	4.40	J	0.250	1.00	5.00	1
ANIONS (mg/L)																												
Chloride	32.2	20 / 20	--	--	5.40		0.0800	0.200	1.00	1			NS				3.60		0.0800	0.200	1.00	1	3.20		0.0800	0.200	1.00	1
Sulfate	10.7	20 / 20	--	--	3.50		0.0900	0.198	1.00	1			NS				9.40		0.0900	0.198	1.00	1	1.00		0.0900	0.198	1.00	1
ALKALINITY (mg/L)																												
Alkalinity, Bicarbonate (as CaCO3)	346	20 / 20	--	--	210		0.850	1.70	2.00	1			NS				181		0.850	1.70	2.00	1	278		0.850	1.70	2.00	1
Alkalinity, Carbonate (as CaCO3)	ND	0 / 20	--	--	1.70	U	0.850	1.70	2.00	1			NS				1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1
Alkalinity, Total (as CaCO3)	346	20 / 20	--	--	210		0.850	1.70	2.00	1			NS				181		0.850	1.70	2.00	1	278		0.850	1.70	2.00	1

Notes:
Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI
Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);
Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

-- = No MCL or RSL designated

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 3-2
PILOT STUDY AREA 2A/2B BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW61-107						MW61-107						MW75-93						MW75-93					
FIELD IDENTIFICATION ¹					FEW4-MW61-107-PS2A-3						FEW4-MW61-107-16						FEW4-MW75-93-15						FEW4-MW75-93-PS2A-1					
DATE COLLECTED					17-Sep-20						22-Oct-20						30-May-20						09-Jul-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	5.9	8 / 19	5	--	5.00	U	2.00	5.00	10.0	10	1.10	J	0.400	1.00	2.00	2	2.50	U	1.00	2.50	5.00	5			NS			
1,1-Dichloroethene	5.5	2 / 19	7	--	5.00	UJ	2.50	5.00	10.0	10	5.50		0.500	1.00	2.00	2	2.50	U	1.25	2.50	5.00	5			NS			
2-Butanone (MEK)	35 J	6 / 19	--	5600	20.0	U	6.00	20.0	100	10	4.00	U	1.20	4.00	20.0	2	10.0	U	3.00	10.0	50.0	5			NS			
2-Hexanone	5.9 J	1 / 19	--	38	20.0	U	9.20	20.0	100	10	4.00	U	1.84	4.00	20.0	2	10.0	U	4.60	10.0	50.0	5			NS			
Acetone	1300 J	6 / 19	--	14000	20.0	U	9.50	20.0	100	10	4.00	U	1.90	4.00	20.0	2	10.0	U	4.75	10.0	50.0	5			NS			
Benzene	0.69 J	2 / 19	5	--	3.00	U	1.50	3.00	10.0	10	0.600	U	0.300	0.600	2.00	2	1.50	U	0.750	1.50	5.00	5			NS			
Carbon disulfide	0.96 J	1 / 19	--	810	5.00	U	2.00	5.00	10.0	10	1.00	U	0.400	1.00	2.00	2	2.50	U	1.00	2.50	5.00	5			NS			
Chloroform	2.1 J	5 / 19	80 ^d	--	3.00	U	0.700	3.00	10.0	10	0.600	U	0.140	0.600	2.00	2	1.50	U	0.350	1.50	5.00	5			NS			
Chloromethane	1.2 J	1 / 19	--	190	5.00	U	2.50	5.00	10.0	10	1.20	J	0.500	1.00	2.00	2	2.50	U	1.25	2.50	5.00	5			NS			
cis-1,2-Dichloroethene	3000	18 / 19	70	--	2100		15.0	30.0	100	100	3000		30.0	60.0	200	200	14.0		0.750	1.50	5.00	5			NS			
Toluene	0.45 J	2 / 19	1000	--	3.00	U	1.50	3.00	10.0	10	0.600	U	0.300	0.600	2.00	2	1.50	U	0.750	1.50	5.00	5			NS			
trans-1,2-Dichloroethene	4.9 J	2 / 19	100	--	3.00	U	1.50	3.00	10.0	10	0.600	U	0.300	0.600	2.00	2	1.50	U	0.750	1.50	5.00	5			NS			
Trichloroethene (TCE)	25000 J	19 / 19	5	--	1600		15.0	30.0	100	100	1400		30.0	60.0	200	200	3500	J	15.0	30.0	100	100			NS			
Vinyl chloride	7.8 J	4 / 19	2	--	7.80	J	1.50	3.00	10.0	10	7.60		0.300	0.600	2.00	2	1.50	U	0.750	1.50	5.00	5			NS			
DISSOLVED GAS (µg/L)																												
Ethane	160	12 / 20	--	--	160		0.510	1.70	5.00	1	81.0		0.510	1.70	5.00	1			NS				1.70	U	0.510	1.70	5.00	1
Ethene	11	8 / 20	--	--	11.0		0.470	1.80	5.00	1	4.80	J	0.470	1.80	5.00	1			NS				1.80	U	0.470	1.80	5.00	1
Methane	480	11 / 20	--	--	22.0		0.250	1.00	5.00	1	9.60		0.250	1.00	5.00	1			NS				1.00	U	0.250	1.00	5.00	1
ANIONS (mg/L)																												
Chloride	32.2	20 / 20	--	--	8.20		0.0800	0.200	1.00	1	2.60		0.0800	0.200	1.00	1			NS				2.80		0.0800	0.200	1.00	1
Sulfate	10.7	20 / 20	--	--	2.90		0.0900	0.198	1.00	1	1.90		0.0900	0.198	1.00	1			NS				7.40		0.0900	0.198	1.00	1
ALKALINITY (mg/L)																												
Alkalinity, Bicarbonate (as CaCO3)	346	20 / 20	--	--	195		0.850	1.70	2.00	1	191		0.850	1.70	2.00	1			NS				166		0.850	1.70	2.00	1
Alkalinity, Carbonate (as CaCO3)	ND	0 / 20	--	--	1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1			NS				1.70	U	0.850	1.70	2.00	1
Alkalinity, Total (as CaCO3)	346	20 / 20	--	--	195		0.850	1.70	2.00	1	191		0.850	1.70	2.00	1			NS				166		0.850	1.70	2.00	1

Notes:
Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI
Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);
Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

-- = No MCL or RSL designated

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 3-2
PILOT STUDY AREA 2A/2B BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW75-93						MW75-93						MW75-93						MW60-90					
FIELD IDENTIFICATION ¹					FEW4-MW75-93-PS2A-2						FEW4-MW75-93-PS2A-3						FEW4-MW75-93-16						FEW4-MW60-90-15					
DATE COLLECTED					21-Aug-20						18-Sep-20						22-Oct-20						28-Jun-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	5.9	8 / 19	5	--	2.60	J	0.800	2.00	4.00	4	2.50	U	1.00	2.50	5.00	5	2.20		0.400	1.00	2.00	2	25.0	U	10.0	25.0	50.0	50
1,1-Dichloroethene	5.5	2 / 19	7	--	2.00	UJ	1.00	2.00	4.00	4	2.50	UJ	1.25	2.50	5.00	5	1.00	U	0.500	1.00	2.00	2	25.0	U	12.5	25.0	50.0	50
2-Butanone (MEK)	35 J	6 / 19	--	5600	8.00	UJ	2.40	8.00	40.0	4	35.0	J	3.00	10.0	50.0	5	10.0	J	1.20	4.00	20.0	2	100	U	30.0	100	500	50
2-Hexanone	5.9 J	1 / 19	--	38	8.00	UJ	3.68	8.00	40.0	4	5.90	J	4.60	10.0	50.0	5	4.00	U	1.84	4.00	20.0	2	100	U	46.0	100	500	50
Acetone	1300 J	6 / 19	--	14000	8.00	UJ	3.80	8.00	40.0	4	16.0	J	4.75	10.0	50.0	5	4.00	U	1.90	4.00	20.0	2	100	U	47.5	100	500	50
Benzene	0.69 J	2 / 19	5	--	1.20	UJ	0.600	1.20	4.00	4	1.50	U	0.750	1.50	5.00	5	0.600	U	0.300	0.600	2.00	2	15.0	U	7.50	15.0	50.0	50
Carbon disulfide	0.96 J	1 / 19	--	810	2.00	UJ	0.800	2.00	4.00	4	2.50	U	1.00	2.50	5.00	5	1.00	U	0.400	1.00	2.00	2	25.0	U	10.0	25.0	50.0	50
Chloroform	2.1 J	5 / 19	80 ^d	--	1.30	J	0.280	1.20	4.00	4	1.50	U	0.350	1.50	5.00	5	1.20	J	0.140	0.600	2.00	2	15.0	U	3.50	15.0	50.0	50
Chloromethane	1.2 J	1 / 19	--	190	2.00	UJ	1.00	2.00	4.00	4	2.50	U	1.25	2.50	5.00	5	1.00	U	0.500	1.00	2.00	2	25.0	U	12.5	25.0	50.0	50
cis-1,2-Dichloroethene	3000	18 / 19	70	--	14.0	J	0.600	1.20	4.00	4	14.0		0.750	1.50	5.00	5	14.0		0.300	0.600	2.00	2	140		7.50	15.0	50.0	50
Toluene	0.45 J	2 / 19	1000	--	1.20	UJ	0.600	1.20	4.00	4	1.50	U	0.750	1.50	5.00	5	0.600	U	0.300	0.600	2.00	2	15.0	U	7.50	15.0	50.0	50
trans-1,2-Dichloroethene	4.9 J	2 / 19	100	--	1.20	UJ	0.600	1.20	4.00	4	1.50	U	0.750	1.50	5.00	5	0.600	U	0.300	0.600	2.00	2	15.0	U	7.50	15.0	50.0	50
Trichloroethene (TCE)	25000 J	19 / 19	5	--	5300		15.0	30.0	100	100	3700		15.0	30.0	100	100	3900		15.0	30.0	100	100	25000	J	75.0	150	500	500
Vinyl chloride	7.8 J	4 / 19	2	--	1.20	UJ	0.600	1.20	2.00	4	1.50	U	0.750	1.50	5.00	5	0.600	U	0.300	0.600	2.00	2	15.0	U	7.50	15.0	50.0	50
DISSOLVED GAS (µg/L)																												
Ethane	160	12 / 20	--	--	4.80	J	0.510	1.70	5.00	1	1.70	U	0.510	1.70	5.00	1	1.70	U	0.510	1.70	5.00	1			NS			
Ethene	11	8 / 20	--	--	1.80	U	0.470	1.80	5.00	1	1.80	U	0.470	1.80	5.00	1	1.80	U	0.470	1.80	5.00	1			NS			
Methane	480	11 / 20	--	--	1.00	U	0.250	1.00	5.00	1	1.80	J	0.250	1.00	5.00	1	1.00	U	0.250	1.00	5.00	1			NS			
ANIONS (mg/L)																												
Chloride	32.2	20 / 20	--	--	0.870	J	0.0800	0.200	1.00	1	2.60	J	0.0800	0.200	1.00	1	1.70		0.0800	0.200	1.00	1			NS			
Sulfate	10.7	20 / 20	--	--	3.00		0.0900	0.198	1.00	1	7.50		0.0900	0.198	1.00	1	3.90		0.0900	0.198	1.00	1			NS			
ALKALINITY (mg/L)																												
Alkalinity, Bicarbonate (as CaCO3)	346	20 / 20	--	--	169		0.850	1.70	2.00	1	165		0.850	1.70	2.00	1	164		0.850	1.70	2.00	1			NS			
Alkalinity, Carbonate (as CaCO3)	ND	0 / 20	--	--	1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1			NS			
Alkalinity, Total (as CaCO3)	346	20 / 20	--	--	169		0.850	1.70	2.00	1	165		0.850	1.70	2.00	1	164		0.850	1.70	2.00	1			NS			

Notes:
Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI
Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);
Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

-- = No MCL or RSL designated

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 3-2
PILOT STUDY AREA 2A/2B BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW60-90						MW60-90						MW60-90						MW60-90					
FIELD IDENTIFICATION ¹					FEW4-MW60-90-PS2B-1						FEW4-MW60-90-PS2B-2						FEW4-MW60-90-16						FEW4-MW60-90-PS2B-4					
DATE COLLECTED					10-Jul-20						02-Sep-20						14-Oct-20						07-Nov-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	5.9	8 / 19	5	--			NS						NS				500	U	200	500	1000	100	50.0	U	20.0	50.0	100	100
1,1-Dichloroethene	5.5	2 / 19	7	--			NS						NS				500	U	250	500	1000	100	50.0	U	25.0	50.0	100	100
2-Butanone (MEK)	35 J	6 / 19	--	5600			NS						NS				2000	U	600	2000	10000	100	200	U	60.0	200	1000	100
2-Hexanone	5.9 J	1 / 19	--	38			NS						NS				2000	U	920	2000	10000	100	200	U	92.0	200	1000	100
Acetone	1300 J	6 / 19	--	14000			NS						NS				1300	J	950	2000	10000	100	200	U	95.0	200	1000	100
Benzene	0.69 J	2 / 19	5	--			NS						NS				300	U	150	300	1000	100	30.0	U	15.0	30.0	100	100
Carbon disulfide	0.96 J	1 / 19	--	810			NS						NS				500	U	200	500	1000	100	50.0	U	20.0	50.0	100	100
Chloroform	2.1 J	5 / 19	80 ^d	--			NS						NS				300	U	70.0	300	1000	100	30.0	U	7.00	30.0	100	100
Chloromethane	1.2 J	1 / 19	--	190			NS						NS				500	U	250	500	1000	100	50.0	U	25.0	50.0	100	100
cis-1,2-Dichloroethene	3000	18 / 19	70	--			NS						NS				1300	J	150	300	1000	100	460		15.0	30.0	100	100
Toluene	0.45 J	2 / 19	1000	--			NS						NS				300	U	150	300	1000	100	30.0	U	15.0	30.0	100	100
trans-1,2-Dichloroethene	4.9 J	2 / 19	100	--			NS						NS				300	U	150	300	1000	100	30.0	U	15.0	30.0	100	100
Trichloroethene (TCE)	25000 J	19 / 19	5	--			NS						NS				19000	J	150	300	1000	100	19000		150	300	1000	100
Vinyl chloride	7.8 J	4 / 19	2	--			NS						NS				300	U	150	300	1000	100	30.0	U	15.0	30.0	100	100
DISSOLVED GAS (µg/L)																												
Ethane	160	12 / 20	--	--	1.70	U	0.510	1.70	5.00	1	1.70	U	0.510	1.70	5.00	1	12.0		0.510	1.70	5.00	1	9.50		0.510	1.70	5.00	1
Ethene	11	8 / 20	--	--	1.80	U	0.470	1.80	5.00	1	1.80	U	0.470	1.80	5.00	1	5.70		0.470	1.80	5.00	1	3.40	J	0.470	1.80	5.00	1
Methane	480	11 / 20	--	--	1.00	U	0.250	1.00	5.00	1	1.00	U	0.250	1.00	5.00	1	16.0		0.250	1.00	5.00	1	4.00	J	0.250	1.00	5.00	1
ANIONS (mg/L)																												
Chloride	32.2	20 / 20	--	--	4.00		0.0800	0.200	1.00	1	9.00		0.0800	0.200	1.00	1	8.10		0.0800	0.200	1.00	1	6.60		0.0800	0.200	1.00	1
Sulfate	10.7	20 / 20	--	--	9.30		0.0900	0.198	1.00	1	10.7		0.0900	0.198	1.00	1	5.60		0.0900	0.198	1.00	1	4.80		0.0900	0.198	1.00	1
ALKALINITY (mg/L)																												
Alkalinity, Bicarbonate (as CaCO3)	346	20 / 20	--	--	223		0.850	1.70	2.00	1	246		0.850	1.70	2.00	1	257		0.850	1.70	2.00	1	252		0.850	1.70	2.00	1
Alkalinity, Carbonate (as CaCO3)	ND	0 / 20	--	--	1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1
Alkalinity, Total (as CaCO3)	346	20 / 20	--	--	223		0.850	1.70	2.00	1	246		0.850	1.70	2.00	1	257		0.850	1.70	2.00	1	252		0.850	1.70	2.00	1

Notes:
Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI
Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);
Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

-- = No MCL or RSL designated

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

TABLE 3-2
PILOT STUDY AREA 2A/2B BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW60-146						MW60-146						MW60-146						MW60-146					
FIELD IDENTIFICATION ¹					FEW4-MW60-146-15						FEW4-MW60-146-PS2B-1						FEW4-MW60-146-PS2B-2						FEW4-MW60-146-16					
DATE COLLECTED					28-Jun-20						10-Jul-20						01-Sep-20						14-Oct-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)																												
1,1,2-Trichloroethane	5.9	8 / 19	5	--	1.00	U	0.400	1.00	2.00	2			NS				5.90		0.800	2.00	4.00	4	1.40	J	0.800	2.00	4.00	4
1,1-Dichloroethene	5.5	2 / 19	7	--	1.00	U	0.500	1.00	2.00	2			NS				2.00	U	1.00	2.00	4.00	4	2.00	U	1.00	2.00	4.00	4
2-Butanone (MEK)	35 J	6 / 19	--	5600	4.00	U	1.20	4.00	20.0	2			NS				8.00	U	2.40	8.00	40.0	4	9.60	J	2.40	8.00	40.0	4
2-Hexanone	5.9 J	1 / 19	--	38	4.00	U	1.84	4.00	20.0	2			NS				8.00	U	3.68	8.00	40.0	4	8.00	U	3.68	8.00	40.0	4
Acetone	1300 J	6 / 19	--	14000	4.00	U	1.90	4.00	20.0	2			NS				18.0	J	3.80	8.00	40.0	4	8.00	U	3.80	8.00	40.0	4
Benzene	0.69 J	2 / 19	5	--	0.600	U	0.300	0.600	2.00	2			NS				1.20	U	0.600	1.20	4.00	4	1.20	U	0.600	1.20	4.00	4
Carbon disulfide	0.96 J	1 / 19	--	810	1.00	U	0.400	1.00	2.00	2			NS				2.00	U	0.800	2.00	4.00	4	2.00	U	0.800	2.00	4.00	4
Chloroform	2.1 J	5 / 19	80 ^d	--	0.600	U	0.140	0.600	2.00	2			NS				2.10	J	0.280	1.20	4.00	4	1.20	U	0.280	1.20	4.00	4
Chloromethane	1.2 J	1 / 19	--	190	1.00	U	0.500	1.00	2.00	2			NS				2.00	U	1.00	2.00	4.00	4	2.00	U	1.00	2.00	4.00	4
cis-1,2-Dichloroethene	3000	18 / 19	70	--	3.70		0.300	0.600	2.00	2			NS				240		0.600	1.20	4.00	4	420		3.75	7.50	25.0	25
Toluene	0.45 J	2 / 19	1000	--	0.600	U	0.300	0.600	2.00	2			NS				1.20	U	0.600	1.20	4.00	4	1.20	U	0.600	1.20	4.00	4
trans-1,2-Dichloroethene	4.9 J	2 / 19	100	--	0.600	U	0.300	0.600	2.00	2			NS				1.20	U	0.600	1.20	4.00	4	1.20	U	0.600	1.20	4.00	4
Trichloroethene (TCE)	25000 J	19 / 19	5	--	2100		3.00	6.00	20.0	20			NS				4900		7.50	15.0	50.0	50	870	J	3.75	7.50	25.0	25
Vinyl chloride	7.8 J	4 / 19	2	--	0.600	U	0.300	0.600	2.00	2			NS				1.20	U	0.600	1.20	2.00	4	1.20	U	0.600	1.20	2.00	4
DISSOLVED GAS (µg/L)																												
Ethane	160	12 / 20	--	--			NS				1.70	U	0.510	1.70	5.00	1	30.0		0.510	1.70	5.00	1	100		0.510	1.70	5.00	1
Ethene	11	8 / 20	--	--			NS				1.80	U	0.470	1.80	5.00	1	1.80	U	0.470	1.80	5.00	1	9.00		0.470	1.80	5.00	1
Methane	480	11 / 20	--	--			NS				1.00	U	0.250	1.00	5.00	1	1.00	U	0.250	1.00	5.00	1	57.0		0.250	1.00	5.00	1
ANIONS (mg/L)																												
Chloride	32.2	20 / 20	--	--			NS				3.80		0.0800	0.200	1.00	1	18.8		0.0800	0.200	1.00	1	11.8		0.0800	0.200	1.00	1
Sulfate	10.7	20 / 20	--	--			NS				10.6		0.0900	0.198	1.00	1	5.10		0.0900	0.198	1.00	1	2.80		0.0900	0.198	1.00	1
ALKALINITY (mg/L)																												
Alkalinity, Bicarbonate (as CaCO3)	346	20 / 20	--	--			NS				165		0.850	1.70	2.00	1	279		0.850	1.70	2.00	1	59.5		0.850	1.70	2.00	1
Alkalinity, Carbonate (as CaCO3)	ND	0 / 20	--	--			NS				1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1	1.70	U	0.850	1.70	2.00	1
Alkalinity, Total (as CaCO3)	346	20 / 20	--	--			NS				165		0.850	1.70	2.00	1	279		0.850	1.70	2.00	1	59.5		0.850	1.70	2.00	1

Notes:
Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI
Bold analytes are site chemicals of concern.

¹Field Identification uses the following naming scheme: site identification-well identification-sample event.

^a Based on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)

^b Based on the USEPA Regional Screening Table for Tap Water (May 2021);
Cancer Risk = 1E-06, Hazard Quotient = 1.0

^d As trihalomethanes

-- = No MCL or RSL designated

µg/L = micrograms per liter

DF = dilution factor

J = estimated

LOD = limit of detection

LOQ = limit of quantitation

MCL = maximum contaminant level

MDL = method detection limit

RSL = regional screening level

U = nondetect

UJ = estimated nondetect

USEPA = United States Environmental Protection Agency

VOC = volatile organic compound

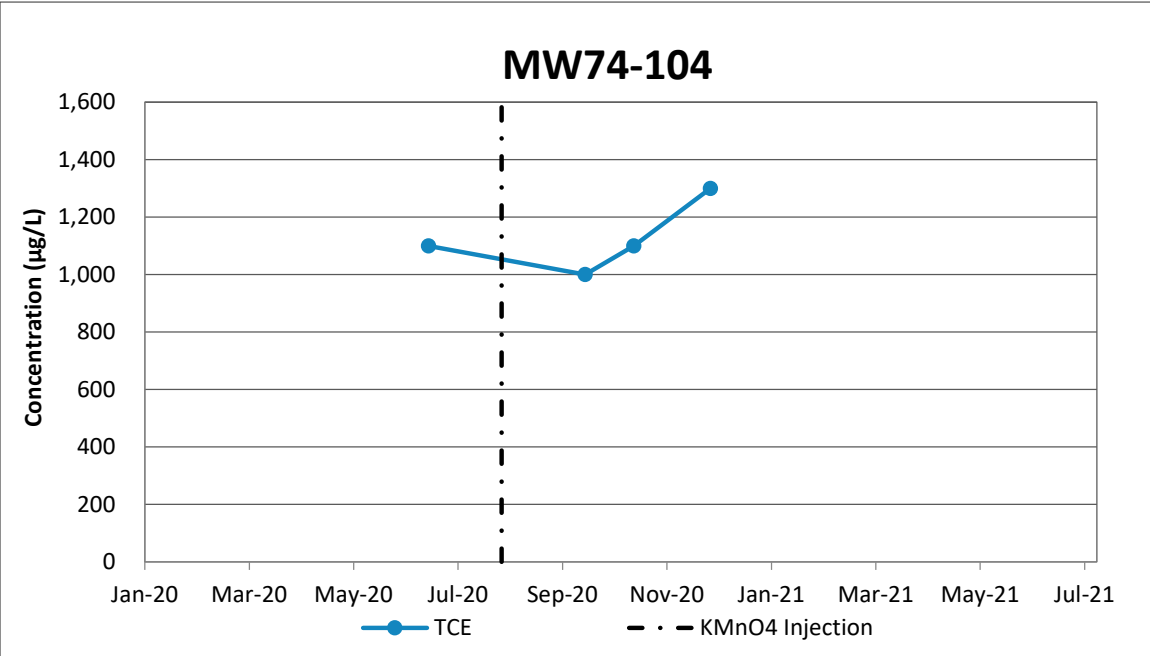
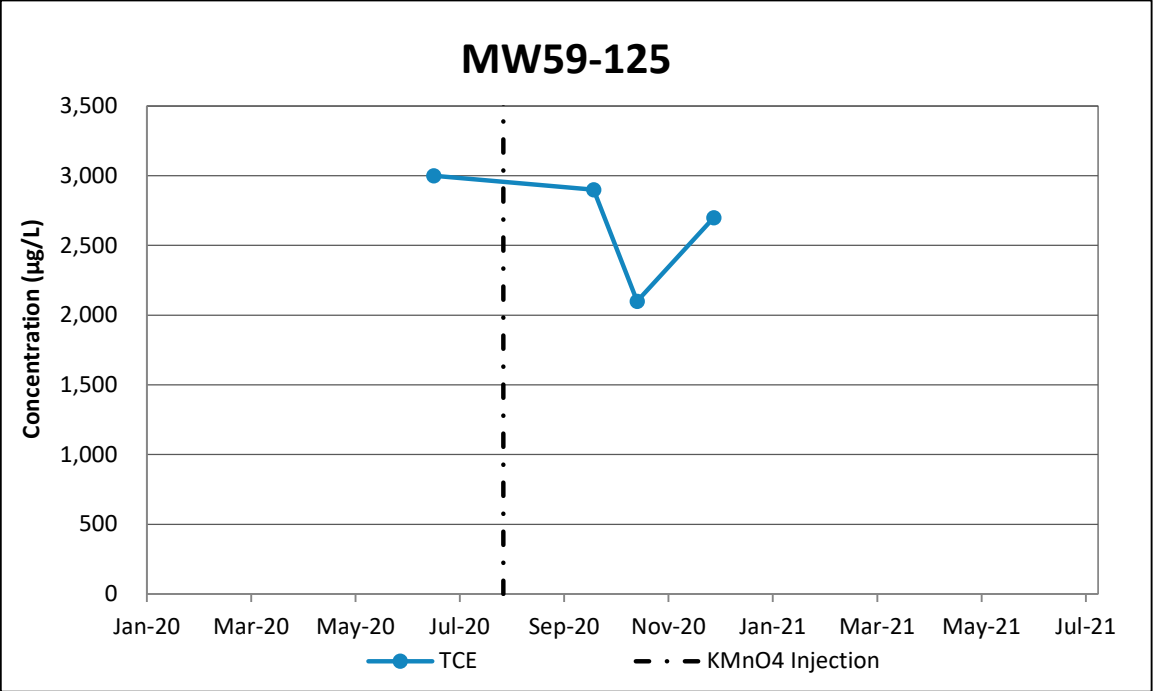
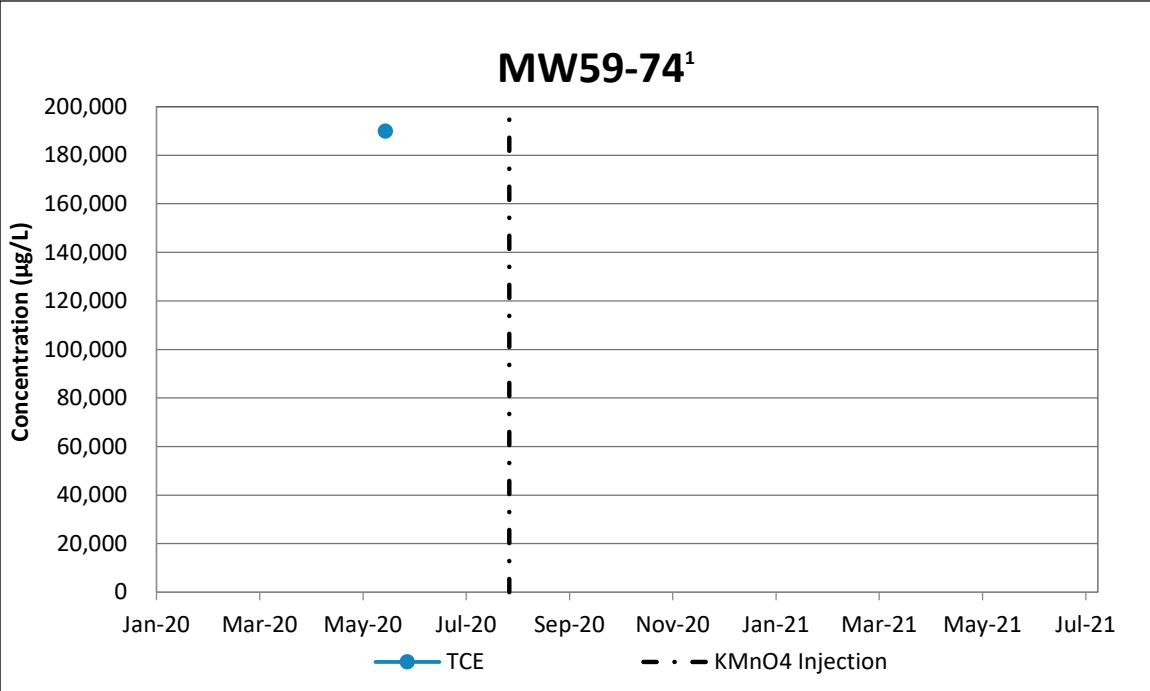
TABLE 3-2
PILOT STUDY AREA 2A/2B BASELINE AND PERFORMANCE MONITORING SAMPLING RESULTS
FORMER ATLAS "D" MISSILE SITE 4

LOCATION IDENTIFICATION					MW60-146					
FIELD IDENTIFICATION ¹					FEW4-MW60-146-PS2B-4					
DATE COLLECTED					07-Nov-20					
	Maximum	Frequency	MCL ^a	RSL ^b	Result	Flag	DL/MDL	LOD	LOQ	DF
VOLATILE ORGANIC COMPOUNDS (µg/L)										
1,1,2-Trichloroethane	5.9	8 / 19	5	--	10.0	U	4.00	10.0	20.0	20
1,1-Dichloroethene	5.5	2 / 19	7	--	10.0	U	5.00	10.0	20.0	20
2-Butanone (MEK)	35 J	6 / 19	--	5600	40.0	U	12.0	40.0	200	20
2-Hexanone	5.9 J	1 / 19	--	38	40.0	U	18.4	40.0	200	20
Acetone	1300 J	6 / 19	--	14000	40.0	U	19.0	40.0	200	20
Benzene	0.69 J	2 / 19	5	--	6.00	U	3.00	6.00	20.0	20
Carbon disulfide	0.96 J	1 / 19	--	810	10.0	U	4.00	10.0	20.0	20
Chloroform	2.1 J	5 / 19	80 ^d	--	6.00	U	1.40	6.00	20.0	20
Chloromethane	1.2 J	1 / 19	--	190	10.0	U	5.00	10.0	20.0	20
cis-1,2-Dichloroethene	3000	18 / 19	70	--	790		15.0	30.0	100	100
Toluene	0.45 J	2 / 19	1000	--	6.00	U	3.00	6.00	20.0	20
trans-1,2-Dichloroethene	4.9 J	2 / 19	100	--	6.00	U	3.00	6.00	20.0	20
Trichloroethene (TCE)	25000 J	19 / 19	5	--	7500		15.0	30.0	100	100
Vinyl chloride	7.8 J	4 / 19	2	--	6.00	U	3.00	6.00	20.0	20
DISSOLVED GAS (µg/L)										
Ethane	160	12 / 20	--	--	81.0		0.510	1.70	5.00	1
Ethene	11	8 / 20	--	--	7.00		0.470	1.80	5.00	1
Methane	480	11 / 20	--	--	19.0		0.250	1.00	5.00	1
ANIONS (mg/L)										
Chloride	32.2	20 / 20	--	--	7.30		0.0800	0.200	1.00	1
Sulfate	10.7	20 / 20	--	--	5.30		0.0900	0.198	1.00	1
ALKALINITY (mg/L)										
Alkalinity, Bicarbonate (as CaCO3)	346	20 / 20	--	--	220		0.850	1.70	2.00	1
Alkalinity, Carbonate (as CaCO3)	ND	0 / 20	--	--	1.70	U	0.850	1.70	2.00	1
Alkalinity, Total (as CaCO3)	346	20 / 20	--	--	220		0.850	1.70	2.00	1

Notes:
Shaded results exceed the MCL; for analytes without MCLs, the results were screened against the RSI
Bold analytes are site chemicals of concern.
¹Field Identification uses the following naming scheme: site identification-well identification-sample event.
^aBased on USEPA Drinking Water Standards and Health Advisories (USEPA 2018)
^bBased on the USEPA Regional Screening Table for Tap Water (May 2021);
Cancer Risk = 1E-06, Hazard Quotient = 1.0
^dAs trihalomethanes
-- = No MCL or RSL designated
µg/L = micrograms per liter
DF = dilution factor
J = estimated
LOD = limit of detection
LOQ = limit of quantitation
MCL = maximum contaminant level
MDL = method detection limit

RSL = regional screening level
U = nondetect
UJ = estimated nondetect
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

TABLE 3-3
KMnO₄ PERFORMANCE MONITORING TRENDS
FORMER ATLAS "D" MISSILE SITE 4



Notes:

¹VOCs could not be analyzed in performance monitoring samples collected in September, October, and December 2020 due to KMnO₄ concentration exceeding ascorbic acid neutralization levels.

KMnO₄ injections were complete between August 7 and 21, 2020.

µg/L = micrograms per liter

KMnO₄ = potassium permanganate

TCE = trichloroethene

VOC = volatile organic compound

TABLE 3-4
GROUNDWATER QUALITY PARAMETERS
FORMER ATLAS MISSILE "D" SITE 4

Field Identification ¹	Date Sample Collected	pH	Temperature (°C)	Conductivity (µS/cm)	DO (mg/L)	Turbidity (NTU)	ORP (mV)
FEW4-MW59-74-15	5/27/2020	7.38	8.47	412	7.35	56.2	12.8
FEW4-MW59-74-PS1-1	7/19/2020	6.70	10.4	392	4.4	NM	33.2
FEW4-MW59-74-16	9/23/2020	NM ²	NM ²	NM ²	NM ²	NM ²	NM ²
FEW4-MW59-74-PS1-3	10/23/2020	NM ²	NM ²	NM ²	NM ²	NM ²	NM ²
FEW4-MW59-74-PS1-4	12/2/2020	NM ²	NM ²	NM ²	NM ²	NM ²	NM ²
FEW4-MW59-125-15	6/28/2020	6.65	9.62	593	3.88	1.20	80.90
FEW4-MW59-125-PS1-1	7/19/2020	5.9	10.2	357	1.7	NM	71.1
FEW4-MW59-125-16	9/28/2020	7.52	9.97	459	1.46	4.26	66.4
FEW4-MW59-125-PS1-3	10/23/2020	7.43	6.76	297	3.49	8.90	-24.5
FEW4-MW59-125-PS1-4	12/6/2020	7.51	9.0	303.2	2.68	2.78	19.4
FEW4-MW74-104-15	6/26/2020	6.88	9.21	262	1.04	5.00	49.60
FEW4-MW74-104-PS1-1	7/19/2020	5.1	9.6	395	0.4	NM	96.8
FEW4-MW74-104-16	9/24/2020	7.82	8.90	400	25.36	NM	-47.10
FEW4-MW74-104-PS1-3	10/22/2020	7.65	6.65	376	2.87	NM	70.2
FEW4-MW74-104-PS1-4	12/5/2020	7.65	7.2	343.5	2.58	385	-33.9
FEW4-MW61-80-15	6/27/2020	6.83	10.30	315	9.35	2.2	42.3
FEW4-MW61-80-PS2A-1	7/9/2020	NM ³	NM ³	NM ³	NM ³	NM ³	NM ³
FEW4-MW61-80-PS2A-2	8/20/2020	6.87	10.51	1325	7.63	NM	-153.3
FEW4-MW61-80-PS2A-3	9/17/2020	8.41	9.43	527	0.74	NM	-136.0
FEW4-MW61-80-16	10/20/2020	6.72	6.57	416	3.87	NM	-70.60
FEW4-MW61-107-15	6/27/2020	7.08	12.52	354	1.46	7.20	-10.1
FEW4-MW61-107-PS2A-1	7/9/2020	6.06	9.6	379	1.7	NM	25.3
FEW4-MW61-107-PS2A-2	8/20/2020	7.24	11.8	681	0.61	NM	-167.4
FEW4-MW61-107-PS2A-3	9/17/2020	7.7	9.4	429	0.8	NM	-129.0
FEW4-MW61-107-16	10/22/2020	6.88	7.28	367	0.24	4.0	-10.0

TABLE 3-4
GROUNDWATER QUALITY PARAMETERS
FORMER ATLAS MISSILE "D" SITE 4

Field Identification ¹	Date Sample Collected	pH	Temperature (°C)	Conductivity (µS/cm)	DO (mg/L)	Turbidity (NTU)	ORP (mV)
FEW4-MW75-93-15	5/30/2020	6.80	12.78	0.361	10.03	3.32	-24.8
FEW4-MW75-93-PS2A-1	7/9/2020	5.73	10.6	346	7.7	NM	78.6
FEW4-MW75-93-PS2A-2	8/21/2020	7.21	10.78	374	4.64	NM	75.8
FEW4-MW75-93-PS2A-3	9/18/2020	7.6	9.6	350	7.6	NM	63.9
FEW4-MW75-93-16	10/22/2020	6.87	6.76	307	6.98	3.02	73.7
FEW4-MW60-90-15	6/28/2020	7.79	11.24	464	1.41	1.91	-173.9
FEW4-MW60-90-PS2B-1	7/10/2020	6.17	11.5	455	0.9	NM	26.0
FEW4-MW60-90-PS2B-2	9/2/2020	7.33	9.92	484	1.38	NM	-88.7
FEW4-MW60-90-16	10/14/2020	6.86	9.67	480	1.36	20	5.8
FEW4-MW60-90-PS2B-4	11/7/2020	7.35	6.24	375	4.32	52.2	-73.1
FEW4-MW60-146-15	6/28/2020	7.95	10.96	361	5.77	18.5	-133.9
FEW4-MW60-146-PS2B-1	7/10/2020	5.58	11.8	348	3.3	NM	93.1
FEW4-MW60-146-PS2B-2	9/1/2020	6.88	9.2	626	1.1	NM	-111.9
FEW4-MW60-146-16	10/14/2020	6.87	9.25	527	1.37	NM	-39.4
FEW4-MW60-146-PS2B-4	11/7/2020	7.30	6.73	329	5.04	50.7	-86.9

Notes:

¹Field Identification uses the following naming scheme: site identification-well identification-sample month and year.

²Water perimeters not collected due to presence of KMnO₄

³Purging completed with disposable bailer.

°C = degrees Celsius

AU = attenuation unit

DO = dissolved oxygen

KMnO₄ = potassium permanganate

mg/L = milligrams per liter

mS/cm = milliSiemens per centimeter

mV = millivolts

NM = not measured

NTU = nephelometric turbidity unit

ORP = oxidation-reduction potential

TABLE 3-5
ZVI PERFORMANCE MONITORING TRENDS
FORMER ATLAS "D" MISSILE SITE 4

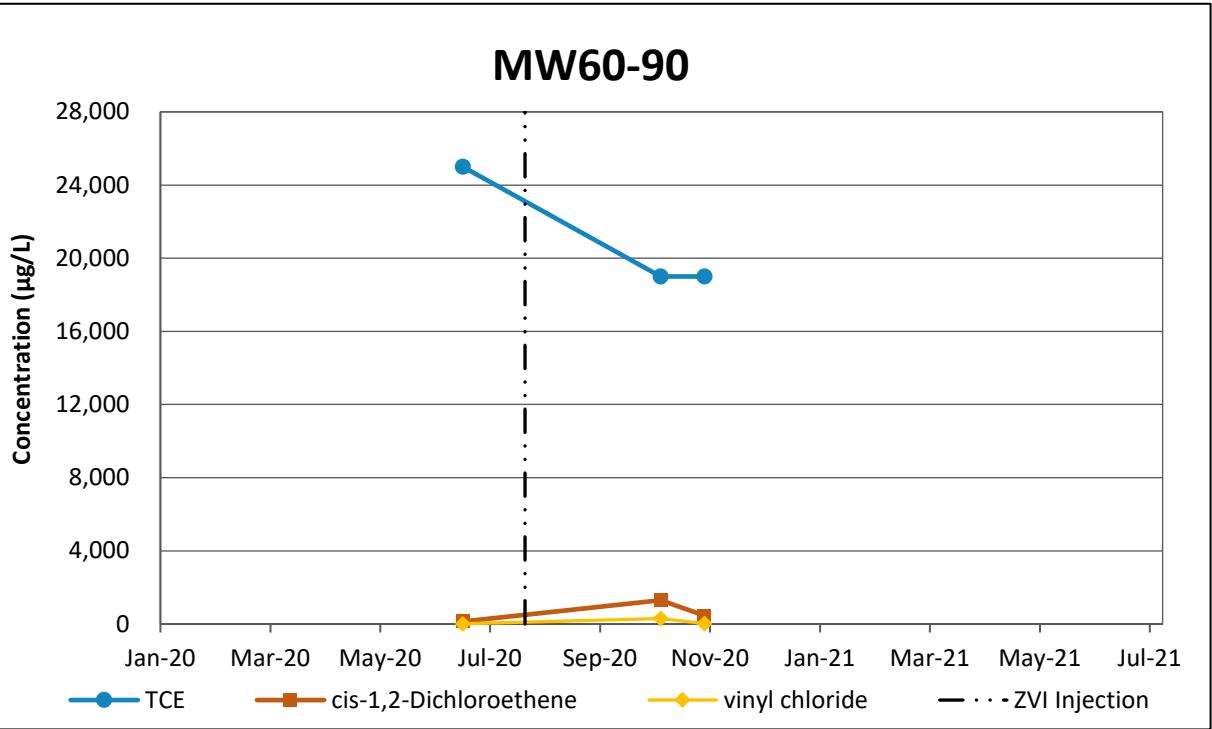
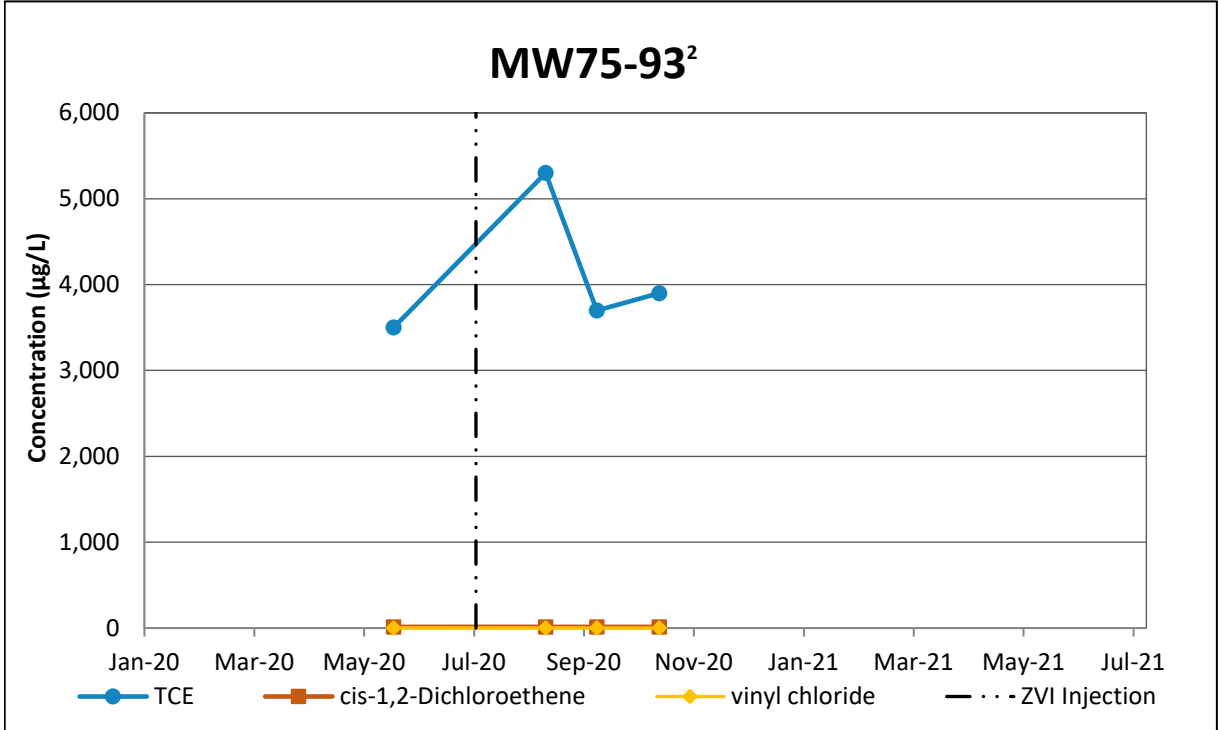
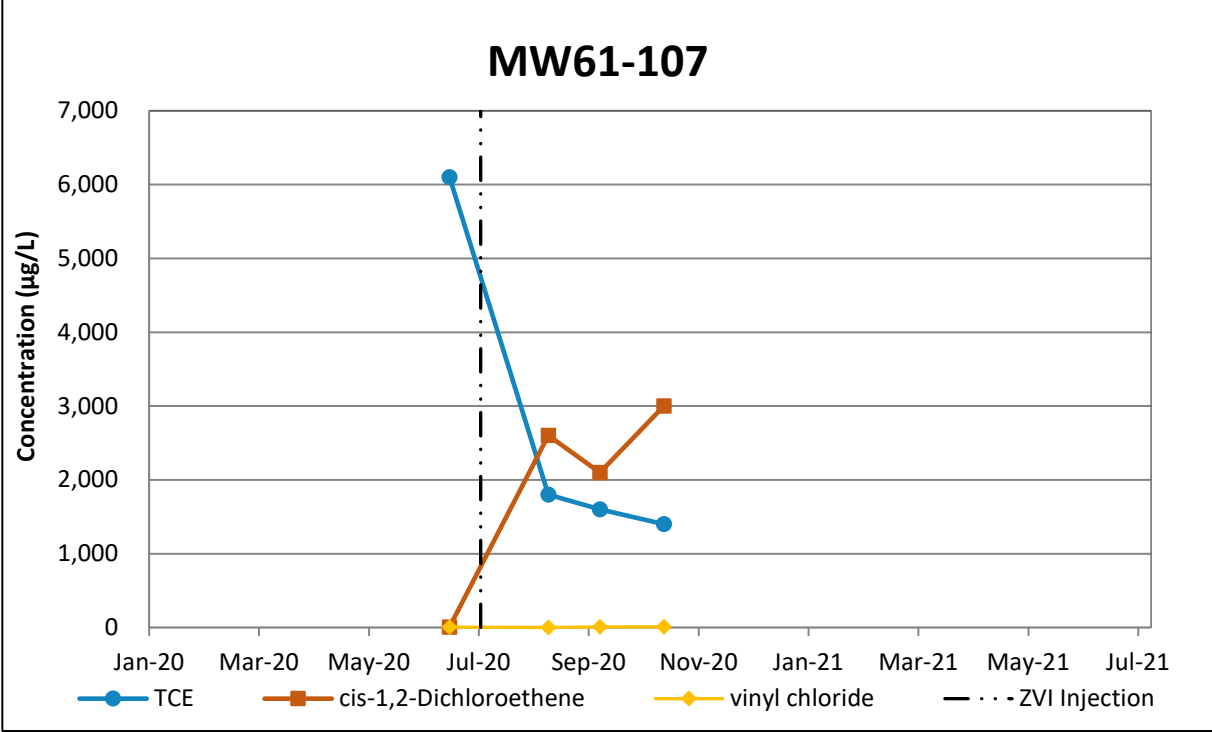
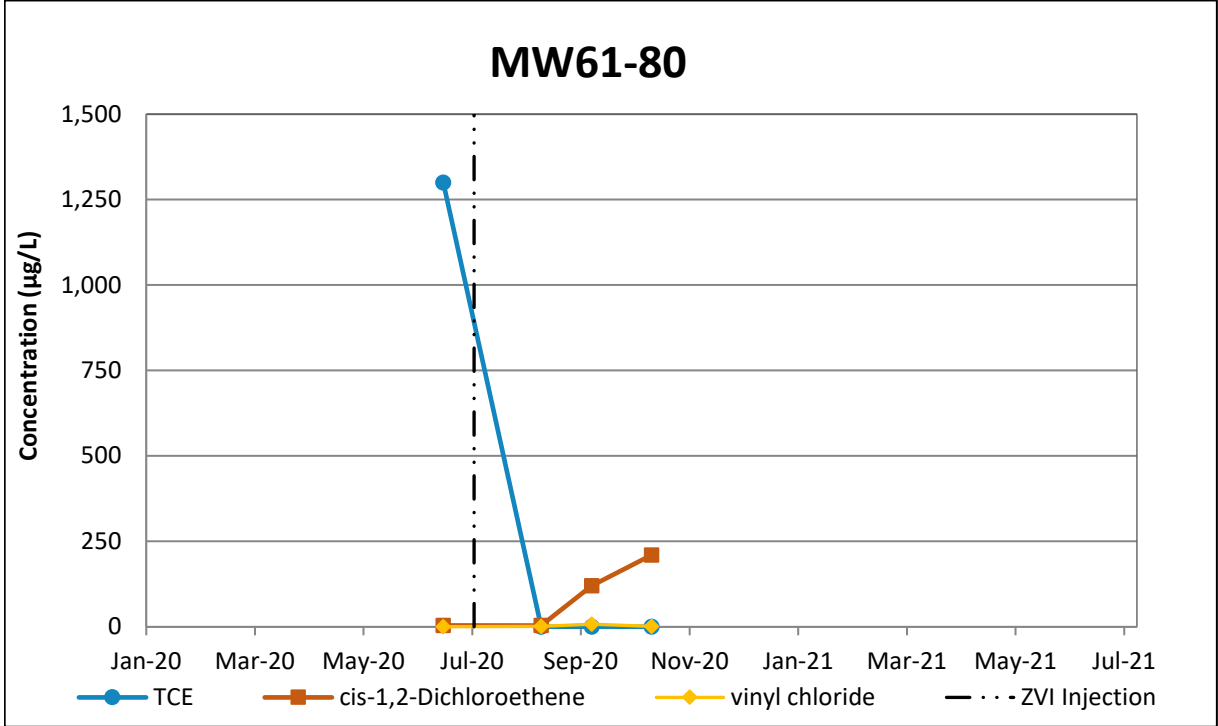
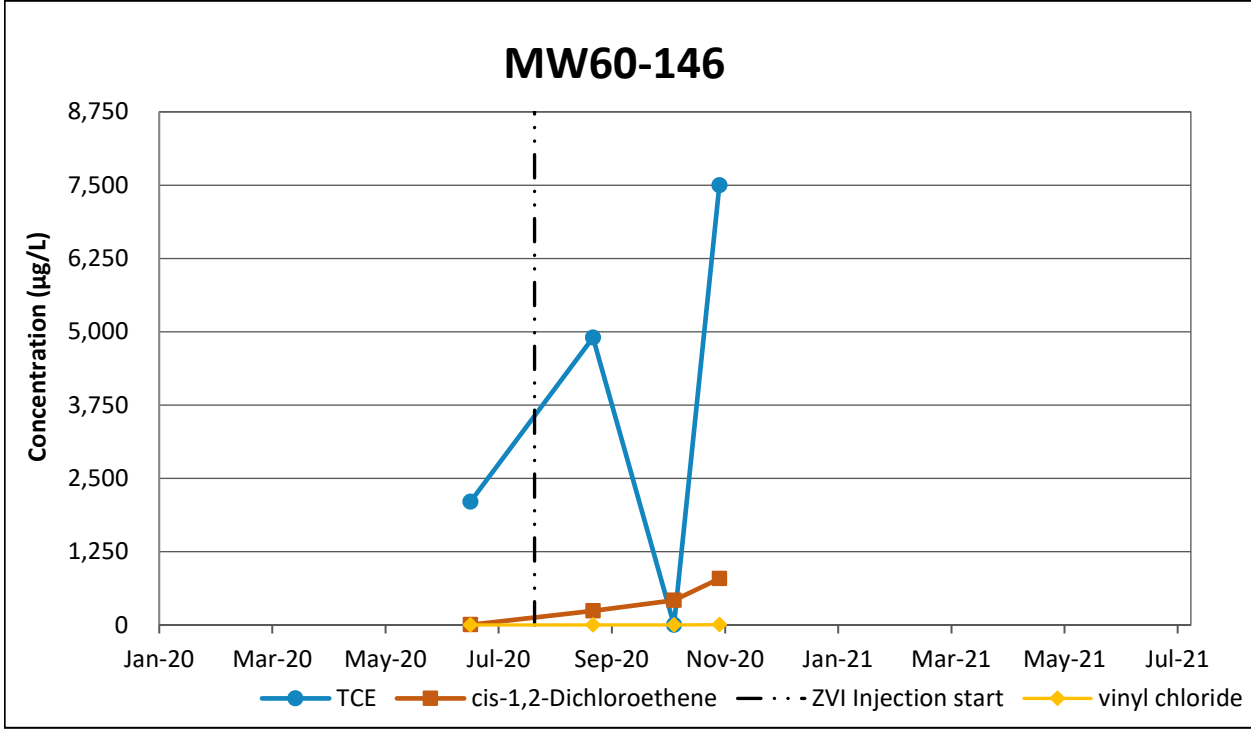


TABLE 3-5
ZVI PERFORMANCE MONITORING TRENDS
FORMER ATLAS "D" MISSILE SITE 4



Notes:

µg/L = micrograms per liter
TCE = trichloroethene
VOC = volatile organic compound
ZVI = zero-valent iron

- Interstate Technology and Regulatory Council. 2011. Permeable Reactive Barrier: Technology Update. Technical/Regulatory Guidance. June.
- URS Group, Inc. (URS). 2020a. Final Site-Wide Uniform Federal Policy-Quality Assurance Project Plan. Former Atlas “D” Missile Site 4, F.E. Warren Air Force Base, Wyoming. August.
- URS. 2020b. Final Long-Term Monitoring and Performance Monitoring Uniform Federal Policy-Quality Assurance Project Plan, Addendum 1. Former Atlas “D” Missile Site 4, F.E. Warren Air Force Base, Wyoming. June.
- URS. 2020c. Final Site-Wide Accident Prevention Plan. Former Atlas “D” Missile Site 4, F.E. Warren Air Force Base, Wyoming. June.
- URS. 2020d. Final Injection Pilot Study Work Plan. Former Atlas “D” Missile Site 4, F.E. Warren Air Force Base, Wyoming. June.
- URS. 2021a. Final Injection Completion Report. Former Atlas “D” Missile Site 4, F.E. Warren Air Force Base, Wyoming. March.
- URS. 2021b. Draft Fall 2020 Long-Term Monitoring Event 16 Report. Former Atlas “D” Missile Site 4, F.E. Warren Air Force Base, Wyoming. March.
- United States Environmental Protection Agency (USEPA). 2020. Regional Screening Levels Summary Table. <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>. November.
- USEPA. 2018. Drinking Water Standards and Health Advisories. March

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 05/21/2020

Project No.: _____
 Field Crew: HK / JBH
 Weather: Sunny, breezy, 60s

Analytical Instruments: pH: YSI 554
 Temp: "
 D.O.: "

Specific Conductivity: YSI 552
 ORP: "
 Turbidity: LaMotte 2020

Well ID: MWS9-74

Type of Well: Monitoring

Casing Stickup: 0

Static Water Level: 51.31' TOC

Well Depth/Diameter: 79.21' TOC

Purging Equipment: Red Flo 2
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x ____ gal/ft = 1 casing volume (gals)

$79.21 - 51.31 = 27.9 \times 0.17 = 4.7 \text{ gal} = 1 \text{ casing}$
 $27.9 \text{ ft water column} \rightarrow 80\% \text{ recovery} = 56.89' \text{ TOC}$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1126	Begin purging									
1129	0.53	0.25	12.92	71.1	925	6.57	0.430	12.19	61.90	0.83
1132	1.1	5	7.78	80.4	923	6.44	0.430	13.4	62.45	0.83
1134	1.4	6.5	Denatured							
1138	water level = 56.89' TOC									
1140	Resume purging									
1143	1.9	0.09	6.67	48.4	901	6.58	0.417	39.4	44	0.83
1148	2.1	10	Denatured							
1200	water level = 52.31' TOC									
1201	Resume purging									
1207	0.11	0.01	7.35	612.9	68.11	7.38	0.412	56.2	57.57	
1210	Collect Sample Flood - MWS9-74									

Depth to water after purging/before sampling 57.57 ft TOC

Sampling Equipment: Red Flo 2 + Reductor tubing

COMMENTS: Denatured Zn

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 PSEP 6 Preservative None 1 liter bottles
 Preservative _____

Sampler Signature(s) Holly my

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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ATTACHMENT 1

Field Forms

GROUNDWATER SAMPLING LOG (revised 8/17.2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 7/19/20

Project No.: 14. MS
 Field Crew: Sunny, 80°F, breeze
 Weather: YSI 556

Analytical Instruments: pH: YSI 556
 Temp: "
 D.O.: "

Specific Conductivity: YSI 556
 ORP: "
 Turbidity: "

Well ID: MW59-74
 Type of Well: "
 Casing Stickup: "
 Static Water Level: 52.7' TOC 7/19/20
 Well Depth/Diameter: 78.5' 12" TOC

Purging Equipment: Radi-Fluor
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

26' - 17 = 4.4 gal.

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1051	Begin purging	2.0	5.6	13.2	9.3	6.6	406	—	62.6	1.0 gpm
1053	1.0	4.0	5.3	32.2	9.7	6.7	404	—	64.9	1.1 gpm
1055		6.0	5.2	37.4	9.8	6.9	403	—	66.1	"
1057		8.0	5.1	42.4	9.9	6.9	400	—	67.1	0.8 gpm
1100		10.0	5.0	31.9	10.0	6.7	397	—	67	"
1103										
1104	De-watered to pump									
1113	WL = 56.0' TOC. Resumed purging									
1115		12.0	4.6	48.5	9.0	6.3	386	—		
1117		14.0	4.8	39.5	9.4	6.5	394	—		
1119		16.0	4.7	37.4	9.7	6.6	394	—		
1122		18.0	4.4	33.2	10.4	6.7	392	—		
1124	Collect Sample									

Depth to water after purging/before sampling 267 ft TOC

Sampling Equipment: collected from discharge tubing

COMMENTS: purge water is clear

Analysis to be performed and Number of Containers:

VOCs 1 Preservative "

TAL Metals 1 Preservative HNO₃

Hexavalent Cr 1 Preservative (NH₄)₂SO₄ + Na₂CO₃ buffer

Sampler Signature(s) Joseph J. [Signature]

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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(revised 8/17.2017)

Project No.: 606133342

Field Crew: JAME

Weather: Sunny 80

Specific Conductivity: NA

ORP: _____

Turbidity:

Purging Equipment: Disposable Barter

CASING VOLUME CALCULATION

$$(TD(ft) - DTW(ft)) \times \text{gal/ft} = 1 \text{ casing volume (gals)}$$
$$25.47 \times 0.17 = 4.33 \frac{\text{gal}}{\text{me}}$$

Well Depth/Diameter: 78.2' / 3'

ME
FW4-MW59-74-16

COMMENTS: * Unable to use YSI-meter to record water quality parameters due to the presence of permanganate in groundwater

Sampling Equipment: Disposable bailer

Sampler Signature(s)

Preservative

Preservative

Preservative

Preservative Ammonium sulfate buffer

Preservative Nitric Acid

Per Pilot Study Work Plan, VOC sample was collected in vials w/ ascorbic acid. Groundwater sample remained purple after reaction w/ ascorbic acid, therefore sample will not be submitted for VOC analysis.

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

(revised 8/17.2017)

Project No.: 606133342
Field Crew: KF, WS
Weather: 12-150 cloudy

Specific Conductivity: 1K 536
ORP: NA
Turbidity: 1 cmo H₂O 2020

Purging Equipment: disposable barrel
CASING VOLUME CALCULATION
 (TD(ft) – DTW(ft)) x ____ gal/ft = 1 casing volume (gals)
 78.2 – 53.3 = 24.9 20.17 = 4.23 gals

[illegible]

COMMENTS: dark purple water.

- * Unable to record water quality parameters due to the presence of potassium permanganate

Sampler Signature(s) 

Former Atlas "D" Missile Site 4

W912DY-16-D-0026, TO W9128F19F0192

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GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
Site Name: Former Atlas D Missile Site 4
Sampling Date: 12/2/20

Project No.: _____
Field Crew: JH, HY
Weather: clear/sunny, windy, 23°F

Analytical Instruments: pH: NA
Temp: _____
D.O: _____

Specific Conductivity: NA
ORP: _____
Turbidity: _____

Well ID: MW59-74
Type of Well: Nesten monitoring
Casing Stickup:
Static Water Level: 53.51
Well Depth/Diameter: 78.2' Dia / 2.1"

Purging Equipment: Disposable Bacteria

CASING VOLUME CALCULATION

$$(TD(ft) - DTW(ft)) \times \text{gal/ft} = 1 \text{ casing volume (gals)}$$
$$24.69 \times .17 = 4.2 \text{ gal}$$
[illegible]

Depth to water after purging/before sampling _____ ft TOC _____

Sampling Equipment: Disposable bawls

Analysis to be performed and Number of Containers:

VOCs NA Preservative
TAL Metals Preservative HN₂
+ Hg Preservative

COMMENTS: purge water is a deep purple color due to potassium permanganate; unable to use water quality meter at this location w/ the KMnO_4 .

Sampler Signature(s) gzh

GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 6/28/20

Project No.: _____
 Field Crew: JK/WJS
 Weather: Sunny 70°F

Analytical Instruments: pH: Ysi Pro Plus
 Temp: ↓
 D.O.: _____

Specific Conductivity: Ysi Pro Plus
 ORP: _____
 Turbidity: LaMotte 2020 We

Well ID: MW 59-125
 Type of Well: nested monitoring
 Casing Stickup: _____
 Static Water Level: 54.3'
 Well Depth/Diameter: 133.05' 70C/12"

Purging Equipment: RediFlo
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x _____ gal/ft = 1 casing volume (gals)

$$133.05' - 54.3' = 78.75' \times 1.7' = 13.39 \times 2 = 26.77$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
0908	Started	purging	16.96	159.3	8.96	6.90	594	7.0	54.30	
0911	.37	5	1.59	232.8	9.12	3.66	598	19.8	80.45	1.67
0916	.75	10	0.98	147.0	9.38	3.21	601	20.5	84.35	1.6
0922	1.12	15	0.97	114.2	9.54	5.88	595	9.1	85.40	1.83
0926	1.49	20	1.23	115.9	9.45	5.82	596	3.8	88.6	1.25
0932	1.86	25	1.93	71.1	10.35	6.79	596	2.14	85.55	1.63
0936	2.24	30	2.39	58.5	10.19	7.04	596	1.16	84.92	1.83
0943	2.6	35	2.47	68.2	9.98	6.91	596	1.7	88.30	1.0
0948	2.99	40	2.80	71.4	9.47	6.78	595	2.5	92.1	1.0
0952	3.36	45	3.14	77.4	9.68	6.73	594	2.0	94.55	1.2
0957	3.73	50	3.55	79.4	9.57	6.66	594	1.7	99.9	1
1002	4.11	55	3.77	81.6	9.66	6.63	594	1.2	93.01	1
1004	4.29	57.5	3.88	80.9	9.62	6.65	593	1.2	95.05	1
1006	Collected	Sample FeW4-MW59-125-19 for VOCs								

Depth to water after purging/before sampling 95.05' ft TOC
 Sampling Equipment: RediFlo discharge tubing

COMMENTS: _____

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 _____ Preservative _____
 _____ Preservative _____

Sampler Signature(s) WJS

ATTACHMENT 1

Field Forms

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4

Site Name: Former Atlas D Missile Site 4

Sampling Date: 7/19/20

Analytical Instruments: pH: YSI 556

Temp: "

D.O: "

Well ID: MW59-125

Type of Well:

Casing Stickup:

Static Water Level: 53.6' TOC - (7/19/20)

Well Depth/Diameter: 132.8' / 2"

Project No.: JM, MS

Field Crew: SUNNY, 80°F, breeze

Weather:

Specific Conductivity: YSI 556

ORP: "

Turbidity: "

Purging Equipment: Redi-Flow 2

CASING VOLUME CALCULATION

(TD(ft) - DTW(ft)) x .17 gal/ft = 1 casing volume (gals)

80' .17 = 13.6 gal

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
0938	Begin Purging									
0941		3.0	2.5	52.7	8.9	6.7	356	-	74.4	1 gpm
0944		6.0	1.0	47.4	9.6	6.7	360	-	81.5	" 2pm
0947		9.0	0.5	20.8	9.9	6.5	360	-	84.6	"
0951	1.0	12.0	0.4	20.0	10.1	6.3	359	-	85.7	0.9 gpm
0954		15.0	0.6	32.4	10.1	6.1	357	-	85.9	"
0959		18.0	0.9	44.2	10.1	6.0	357	-	85.7	"
1002		21.0	1.1	53.7	10.1	6.0	357	-	85.6	"
1006		24.0	1.5	63.0	10.2	5.9	357	-	85.7	"
1010	2.0	27.0	1.7	71.1	10.2	5.9	357	-	85.9	"
1012	Collect Sample									
Sample FE W4-MW59-125 - PS28 + gm										
PSI-1										

Depth to water after purging/before sampling: ~ 86.0 ft TOC

Sampling Equipment: Collected from dredge tubing

COMMENTS: purge water is very clear

Analysis to be performed and Number of Containers:

VOCs

Preservative

TAL Metals

Preservative

Hexavalent Cr

Preservative

HNO₃

(NH₄)₂SO₄ + NH₄OH buffer

Sampler Signature(s)

Joyl Martindale

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 9/28/2020

Project No.: 606133342
 Field Crew: JH, TM
 Weather: Pickinly, Breezy

Analytical Instruments: pH: YSI-554
 Temp: ↓
 D.O.: ↓

Specific Conductivity: YSI-552
 ORP: ↓
 Turbidity: LaMotte "2020"we

Well ID: MW59-125
 Type of Well: Nested monitoring
 Casing Stickup: 53.12' TOC 1' 54.57' TOC
 Static Water Level: 53.12' TOC 1' 54.57' TOC
 Well Depth/Diameter: 132.5' TOC 12"

Purging Equipment: Grundfos Redi-Flow pump
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x 13 gal/ft = 1 casing volume (gals)
12.55' casing vol.
 $71.93 \times 0.17 = 13.2 \text{ gals} = 1 \text{ casing vol.}$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate (gpm)
1103	begin	purging						clear		
1106		2.5						10.33	69.60	
1110	0.4	5.0	6.69	112.2	9.60	7.46	495	57.6	72.21	0.7
1117	0.8	10.0	6.90	87.3	9.74	7.57	489	1.532	78.97	0.7
1123	1.1	15.0	6.62	75.9	9.71	7.56	468	*37	83.51	0.8
1129	1.5	20	6.69	73.1	9.92	7.51	463	46.5	84.31	0.8
1135	1.9	25	6.81	69.1	9.85	7.53	463	19.8	85.71	0.8
1140	2.3	30	1.01	66.7	9.74	7.51	460	11.49	86.22	1.0
1147	2.6	35	1.27	67.0	9.83	7.51	462	6.74	86.56	0.7
1154	3.0	40	1.46	66.4	9.97	7.52	458	4.26	86.32	
1156	Collect Sample		FEW-4-MW59-125-16							

Depth to water after purging/before sampling 86.32 ft TOC
 Sampling Equipment: Redi-Flow 2 pump

COMMENTS: * Water is cloudy; turbidity readings does not appear accurate

Analysis to be performed and Number of Containers:
 VOCs 3 Preservative HCl
 Hexavalent Chromium 1 Preservative Ammonium Sulfate Buffer
 TCL Metals 1 Preservative Nitric Acid

Sampler Signature(s) [Signature]

Site-Wide UFP-QAPP
 Former Atlas "D" Missile Site 4
 F.E. Warren Air Force Base, Wyoming
 W912DY-16-D-0026, TO W9128F19F0192

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GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 10/23/20

Project No.: 606133342
 Field Crew: 1 R, WS
 Weather: 18° cloudy

Analytical Instruments: pH: VSI 556
 Temp: ↓
 D.O.: ↓

Specific Conductivity: VSI 556
 ORP: "
 Turbidity: 1000+ 2020

Well ID: MW 59-125
 Type of Well: Nested monitoring
 Casing Stickup:
 Static Water Level: 56.3' TOC
 Well Depth/Diameter: 132.5' TOC / 2"

Purging Equipment: rediflo II
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)
76.2 x 0.17 = 13 gals
pump ~ 116' TOC

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1232	begin	pump								
1240		10	2.61	5.0	5.97	7.37	318	23.4	79.80	0.63
1246		10	1.58	-17.9	6.54	7.33	312	10.4	80.4	0.83
1253	1.15	15	1.57	-29.3	6.61	7.33	208	56	81.5	0.71
1259		20	1.82	-33.8	6.63	7.34	304	50.1	83.50	0.83
1306	1.92	25	2.63	-35.7	6.70	7.37	305	24.0	83.90	0.71
1312		30	2.08	-34.9	6.78	7.38	302	14.4	84.20	0.83
1319		35	2.79	-32.1	6.81	7.40	300	10.70	84.2	0.71
1325		40	3.04	-30.0	6.74	7.40	299	7.11	84.20	0.83
1332	3.46	45	3.31	-26.7	6.75	7.41	298	6.47	84.36	0.71
1340		50	3.14	-24.5	6.76	7.43	297	5.90	84.25	0.63
1342	3.85	collect sample								

Depth to water after purging/before sampling 84.25 ft TOC
 Sampling Equipment: rediflo II

COMMENTS: TCE = 3,000 µg/L last known

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
TAL Metals Preservative HNO₃
 Preservative

Sampler Signature(s) [Signature]

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 12/6/20

Project No.: _____
 Field Crew: JH, PC
 Weather: Sunny & cool, windy, 38°F

Analytical Instruments: pH: YSI PRO-PLUS
 Temp: _____
 D.O.: _____

Specific Conductivity: YSI PRO PLUS
 ORP: _____
 Turbidity: HACH 2100Q

Well ID: MW59-125
 Type of Well: Nestor Monitoring
 Casing Stickup: _____
 Static Water Level: 54.68' TOC
 Well Depth/Diameter: 132.5' / 2" TC

Purging Equipment: Grundfos Redi-Flow 2 pump

CASING VOLUME CALCULATION

(TD(ft) - DTW(ft)) x _____ gal/ft = 1 casing volume (gals)

$$77.82 \times 0.17 = 13.2 \text{ gal}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate gpm
0856	Begin	purging	1.24	113.4	6.7	7.75	312.8	26.5	161.4	0.8
0902		5	0.43	57.2	8.4	7.49	307.0	20.1	74.65	0.8
0909	0.8	10	0.34	-29.4	8.7	7.36	310.9	28.7	81.91	0.7
0914		15	0.60	-20.3	8.7	7.29	307.7	72.3	89.07	1.0
0921	1.5	20	0.81	-26.0	8.9	7.55	304.9	86.8	88.20	0.8
0927		25	1.22	-77.6	8.9	7.52	305.8	23.7	88.25	0.8
0933	2.3	30	1.55	-5.7	9.0	7.51	305.1	8.46	88.25	0.8
0939		35	1.92	2.7	9.0	7.49	304.4	5.57	88.40	0.8
0948	3.1	40	2.22	10.3	9.0	7.52	305.1	4.01	88.45	0.8
0951		45	2.49	14.8	9.0	7.51	304.5	3.12	88.46	0.8
0957	3.8	50	2.68	19.4	9.0	7.51	303.2	2.78	88.70	0.8
1000	Collect	Sample for MW59-125-PSI-4								

Depth to water after purging/before sampling 88.70 ft TOC _____
 Sampling Equipment: Redi-Flow 2 pump

COMMENTS: _____

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCL
TAL Metals + Hg Preservative HNO3
 Preservative _____

Sampler Signature(s) [Signature]

GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 6/28/2020

Project No.: 60613342
 Field Crew: JL, BB
 Weather: _____

Analytical Instruments: pH: YSI-556
 Temp: ↓
 D.O: ↓

Specific Conductivity: YSI-556
 ORP: ↓
 Turbidity: LaMotte 2000ce

Well ID: MW60-90
 Type of Well: nested monitoring
 Casing Stickup: _____
 Static Water Level: 63.70' TOC
 Well Depth/Diameter: 97.75' TOC 12"

Purging Equipment: RediFlo2
 CASING VOLUME CALCULATION
 $(TD(ft) - DTW(ft)) \times 0.17 \text{ gal/ft} = 1 \text{ casing volume (gals)}$
 $(97.75 - 63.70) \times 0.17 = 5.79 \text{ gal}$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate gal/min
1304	Begin purging									
1310	0.86	5.0	1.46	-156.2	10.56	7.54	469	8.63	79.9	0.83
1310	Pause pumping for recharge									
1313	Water level is 73' TOC 780% recharge									
1322	Resume purging									
1324	1.65	2.0 (7.0)	1.72	-183.1	9.67	7.85	451	4.86	73.2	1.00
1327	1.55	4.0 (9.0)	0.93	-186.1	10.99	7.66	478	5.67	76.6	0.80
1332	1.89	6.0 (11.0)	1.08	-185.3	11.41	7.75	469	3.44	77.4	0.60
1333	Pause pumping									
1344	Water level is 66.0' TOC									
1345	Begin purging									
1347	2.24	2.0 (13.00)	1.75	-183.7	9.52	8.03	440	2.08	71.8	1.00
1350	2.60	4.0 (15.00)	1.42	-181.0	10.57	7.79	460	3.49	75.2	0.80
1353	2.93	6.0 (17.0)	1.41	-173.9	11.24	7.79	464	1.91	76.0	0.83

Depth to water after purging/before sampling 76 ft TOC

Sampling Equipment: collected from discharge tubing

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 _____ Preservative _____
 _____ Preservative _____

COMMENTS: _____

Sampler Signature(s) _____

GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
Site Name: Former Atlas D Missile Site 4
Sampling Date: 6/26/10

Project No.: 60613342
Field Crew: JM, BB
Weather: overcast, breezy

Analytical Instruments: pH: 4.51-5.56
Temp:
D.O:

Specific Conductivity: YSI-556
ORP: ↓
Turbidity: La Motte, MO, one

Well ID: MW60-90
Type of Well: nested monitoring
Casing Stickup:
Static Water Level: 63.70' TDC
Well Depth/Diameter: 97.75' TDC 12"

Purging Equipment: RediFlo2

CASING VOLUME CALCULATION

$$(TD(ft) - DTW(ft)) \times 5.79 \text{ gal/ft} = 1 \text{ casing volume (gals)}$$
[illegible]

Depth to water after purging/before sampling 276 ft TOC _____

Sampling Equipment: collected from discharge tubing

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 _____ Preservative _____
 _____ Preservative _____

COMMENTS: _____

Sampler Signature(s) [Signature]

GROUNDWATER SAMPLING LOG (revised 8/17.2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 7/10/20

Analytical Instruments: pH: YSI 556
 Temp: "
 D.O.: "

Well ID: MW60-90
 Type of Well: monitor (nested)
 Casing Stickup: 63.93' TOC (7/10/20)
 Static Water Level: 97.7' / 2"
 Well Depth/Diameter: 97.7' / 2"

Project No.: 1M, MS
 Field Crew: Sunny, 83°F, slight breeze
 Weather: Sunny, 83°F, slight breeze

Specific Conductivity: YSI 556
 ORP: "
 Turbidity: "

Purging Equipment: Redi-Flow 2

CASING VOLUME CALCULATION

(TD(ft) - DTW(ft)) x .17 gal/ft = 1 casing volume (gals)

$$33.8' \cdot .17 = 5.7 \text{ gal.}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1008	Begin Purging	2.0	1.0	53.4	10.1	6.08	442	—	74.9	
1012		4.0	0.6	48.3	10.9	6.35	461	—	77.3	
1014	1.0	6.0	0.3	21.8	11.5	6.32	470	—	78.0	
1018		8.0	0.5	11.6	11.5	6.11	459	—	78.3	
1023		10.0	0.8	19.6	11.5	6.08	458	—	78.6	
1028		12.0	0.9	26.0	11.5	6.17	455	—	78.7	
1032	2.1									
1034	Collect Sample									
FEW4-MW60-90-152B-1										

Depth to water after purging/before sampling ft TOC
 Sampling Equipment: Collected from discharge tubing

Analysis to be performed and Number of Containers:

RSK-175 3 Preservative HCl
chloride/sulfate 1 Preservative 4°C
alkalinity 1 " 4°C

COMMENTS: Purge water is clear

Sampler Signature(s) [Signature]

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 9/2/20

Project No.: _____
 Field Crew: JK, JW, JM
 Weather: Sunny, 75°

Analytical Instruments: pH: YSI 556
 Temp: LI
 D.O.: LI

Specific Conductivity: YSI 556
 ORP: LI
 Turbidity: LI

Well ID: MW60
MW60-90

Purging Equipment: Syler

Type of Well: monitoring

CASING VOLUME CALCULATION

Casing Stickup: _____

(TD(ft) - DTW(ft)) x _____ gal/ft = 1 casing volume (gals)

Static Water Level: 64.21 BTOC

Well Depth/Diameter: 97.7/2"

$$33.5 \times 17 = 5.7 \text{ gal}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3% [µS/cm])	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
begin bailing 1054										
1104		2.5	3.45	30.2	9.98	8.61	457			
1111		5	1.47	-5.9	9.43	7.57	475			
1123		7.5	1.56	-16.4	9.16	7.48	495			
1132		10.1	1.38	-8.8	9.83	7.33	484			
1138	collected sample									

Depth to water after purging/before sampling _____ ft TOC _____

Sampling Equipment: Disposable Bailor

COMMENTS: _____

Analysis to be performed and Number of Containers:

VOCs 3 Preservative _____

RSK-115 3 Preservative _____

chloride/sulfate, AR Preservative _____

Sampler Signature(s) Joseph Martorella

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 10/14/20

Project No.: 606133342
 Field Crew: TM/JMH
 Weather: Very Windy, Sunny 50°

Analytical Instruments: pH: 451 586
 Temp: ↓
 D.O.: ↓

Specific Conductivity: 451 586
 ORP: ↓
 Turbidity: LAMOTTE 2020

Well ID: MW60-90
 Type of Well: Monitoring
 Casing Stickup: 64.95' TOC
 Static Water Level: 97.7' / 2"
 Well Depth/Diameter: 97.7' / 2"

Purging Equipment: BAUER
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x ____ gal/ft = 1 casing volume (gals)

$$97.7 - 64.95 = 32.75 \times 0.17 = 5.6 \text{ gal (1 casing)} \times 2 = 11.2 \text{ gal (2 casings)}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
0920	BEGIN BAILING								64.95	NA
0926	0.18	1	2.19	13.5	9.76	7.15	590	4.75	-	-
0937	0.54	3	1.66	21.0	8.63	7.06	462	20.0	-	-
0947	0.89	5	1.08	20.4	9.27	6.92	472	23.5	-	-
0959	1.25	7	1.04	15.5	9.07	6.77	519	35.21 AU/PAGE	-	-
1008	1.61	9	1.11	10.6	9.51	6.88	483	118 CAL "	-	-
1023	2.14	12	1.36	5.8	9.67	6.86	480	- 20 NTU?	-	-
1030	COLLECT FEW 4-MW60-90-16 FOR VOCs, RSK-175, CHLORIDE, SULFATE, ALKALINITY									

Depth to water after purging/before sampling _____ ft TOC
 Sampling Equipment: DISPOSABLE BAUER

COMMENTS: INITIAL PURGE WATER IS GRAY/OPOR, PULLED 2 CASING VOLUMES

Analysis to be performed and Number of Containers:
 VOCs 3 Preservative HCl
RSK-175 3 Preservative HCl
CHLORIDE/SULFATE/ALK Preservative 4°C

Sampler Signature(s) [Signature]

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

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GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 11/7/20

Project No.: 606133342
 Field Crew: JMH, ME
 Weather: 52°F, cloudy

Analytical Instruments: pH: YSI 556
 Temp: ↓
 D.O: ↓

Specific Conductivity: YSI 556
 ORP: ↓
 Turbidity: LaMotte 2020

Well ID: MW60-90
 Type of Well: nested monitoring
 Casing Stickup: 64.63' TOC
 Static Water Level: 97.7' TOC / 2"
 Well Depth/Diameter: 97.7' TOC / 2"

Purging Equipment: Disposable Bailor
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$$97.7 - 64.63 = 33.07 \times 0.17 = 5.62 \text{ gallons} \times 2 = 11.24 \text{ gallons}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
0844	Begin	Bailing well								
0905	0.36	2	7.45	110.4	7.01	6.96	433	10.11	NA	NA
0924		4	5.04	-38.6	6.37	7.26	395	13.5		
0937	1.07	6	4.70	-68.1	6.43	7.28	390	20.3		
0948		8	3.45	-74.5	6.33	7.32	385	36.2		
1000	1.78	10	4.10	-77.4	6.28	7.31	383	36.1		
1011	2.07	12	4.32	-73.1	6.24	7.35	375	52.2		
1015	collected sample FEW4-MW60-90-16 for VOCs, RSK-175, Chloride, Sulfate, Alkalinity JMH FEW4-MW60-90-PS2B-4									

Depth to water after purging/before sampling NA ft TOC
 Sampling Equipment: Disposable Bailor

COMMENTS: _____

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 RSK-175 3 Preservative HCl
 Chloride/Sulfate/ALK Preservative 4°C

Sampler Signature(s) Joshy Nunez

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

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GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 6/28/2020

Project No.: 60613342
 Field Crew: JM, BB
 Weather: overcast, slight breeze

Analytical Instruments: pH: YSI-556
 Temp: ↓
 D.O: ↓

Specific Conductivity: YSI-556
 ORP: ↓
 Turbidity: La Motte 2020we

Well ID: MW60-146
 Type of Well: nested monitoring
 Casing Stickup:
 Static Water Level: 63.24' TOC
 Well Depth/Diameter: 150.98' TOC 12"

Purging Equipment: Redit102
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x .17 gal/ft = 1 casing volume (gals)
 (150.98 - 63.24) .17 = 14.75 gal

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate gal/min
1020	Begin Purging									
1025	0.34	5.0	1.70	8.8	9.64	6.57	364	6.41	93.6	1.00
1030	0.70	10.0	1.18	-33.3	10.03	7.14	363	8.19	111.0	1.00
1036	1.02	15.0	1.65	-70.1	10.37	7.49	363	20.10	123.8	0.94
1041	1.36	20.0	2.27	-98.2	10.62	7.73	364	49.00	131.2	0.95
1042	Pause pumping to allow recharge									
1111	Water level is 76.2' TOC > 800% recharge									
1112	Resume purging									
1119	1.69	5.0 (25.0)	3.49	-123.8	10.16	7.49	365	14.50	93.10	0.71
1130	2.03	10.0 (30.0)	3.94	-135.5	11.14	7.95	364	15.20	105.5	0.56
1138	2.37	15.0 (35.0)	3.98	-142.7	10.67	8.00	365	38.90	115.2	0.58
1147	2.71	20.0 (40.0)	4.59	-131.0	10.93	8.03	365	21.0	122.0	0.57
1156	3.05	25.0 (45.0)	5.07	-128.0	11.06	8.07	364	37.8	124.5	0.57
1203	3.39	30.0 (50.0)	5.12	-130.1	11.00	8.06	364	38.1	127.8	0.58
1211	3.73	35.0 (55.0)	5.56	-126.8	11.11	8.15	363	29.0	129.8	0.57

Depth to water after purging/before sampling ~108 ft TOC
 Sampling Equipment: collected from discharge tubing

COMMENTS: Unable to achieve stable parameters after 2+ hrs of pumping

Analysis to be performed and Number of Containers:
 VOCs 3 Preservative HCl
 _____ Preservative _____
 _____ Preservative _____

Sampler Signature(s)

[Signature]

GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
Site Name: Former Atlas D Missile Site 4
Sampling Date: 4/28/2020

Project No.: 60613342
Field Crew: JM, BB
Weather: overcast, windy

Analytical Instruments: pH: YSI 556
Temp: ↓
D.O: ↓

Specific Conductivity: 451 5510
ORP:
Turbidity: LaMotte 2020 we

Well ID: MW60-146
Type of Well: nested monitoring
Casing Stickup:
Static Water Level: 63.24' TOC
Well Depth/Diameter: 150.98' TOC / 2"

Purging Equipment: Red F102

CASING VOLUME CALCULATION

$$(TD(ft) - DTW(ft)) \times 1.7 \text{ gal/ft} = 1 \text{ casing volume (gals)}$$

14.75 gal

[illegible]

Depth to water after purging/before sampling 408 ft TOC

Sampling Equipment: collected from discharge tubing

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
Preservative
Preservative

COMMENTS: _____

Sampler Signature(s)

Revised 8.17.2017

ATTACHMENT 1

Field Forms

GROUNDWATER SAMPLING LOG (revised 8/17.2017)

Project Name: F.E. Warren Atlas Site 4

Site Name: Former Atlas D Missile Site 4

Sampling Date: 7.10.20

Analytical Instruments: pH: YSI 556

Temp: _____ °F

D.O:

Well ID: MW60-146

Type of Well: _____

Casing Stickup: _____

Static Water Level: 63.55' T.C. (7.10.20)

Well Depth/Diameter: 150.9' dia 72"

Project No.: _____

Field Crew: IM, MS

Weather: SUNNY 80°F calm

Specific Conductivity: 452 556

ORP: 67

Turbidity:

Purging Equipment: Redi-Flo 2

CASING VOLUME CALCULATION

$$(TD(ft) - DTW(ft)) \times 17 \text{ gal/ft} = 1 \text{ casing volume (gals)}$$
$$88.6 \cdot .17 = 15 \text{ gal.}$$
[illegible]

Depth to water after purging/before sampling, ~126.5 ft TOC

Sampling Equipment: Collected from discharge

Analysis to be performed and Number of Containers:

~~VOCS~~ Preservative

RSK-175 - 3 Preservative HCl

Chloride / Sulfate - 1 Preservative 4°C

4) 400

Alkalinity = 170

COMMENTS: Purge water is slightly turbid/

mostly clear.

Sampler Signature(s) Stacy Maslowski

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026. TO W9128F19F0192

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GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
Site Name: Former Atlas D Missile Site 4
Sampling Date: 9/1/20

Analytical Instruments: pH: YSI 556
Temp: 21
D.O: 16

Project No.: _____
Field Crew: JK LMK LM
Weather: Sunny, 78, breeze

Specific Conductivity: YSI 556
ORP: 11
Turbidity: —

Well ID: MW60-146
Type of Well: monitor: n/g
Casing Stickup:
Static Water Level: 66.50' TO C
Well Depth/Diameter: 150 / 2"

Purging Equipment: Redi-Flow 2 - Disposable Baiter

CASING VOLUME CALCULATION

$$(TD(ft) - DTW(ft)) \times \text{gal/ft} = 1 \text{ casing volume (gals)}$$

14.3 g/L

[illegible]

Depth to water after purging/before sampling _____ ft TOC _____

Sampling Equipment: Bailer

Analysis to be performed and Number of Containers:

VOCs 3 Preservative ACI

LSK-175 3. Preservative HCl

oxide / SO_2 / Fats / Alk. Preservative 4°C

COMMENTS: Speculate that dissolved iron in the water is interfering w/ pump operation (EM field degradation in pump coils)

Sampler Signature(s) Jean Adams

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 10/14/20

Project No.: 606133342
 Field Crew: TM/TMH
 Weather: VERY WINDY, SUNNY

Analytical Instruments: pH: YSI 556
 Temp: ↓
 D.O: ↓

Specific Conductivity: YSI 556
 ORP: ↓
 Turbidity: LA MOTTE 2020

Well ID: MW60-146
 Type of Well: MONITORING
 Casing Stickup: 69.58' TOC
 Static Water Level: 69.58' TOC
 Well Depth/Diameter: 150' 12"

Purging Equipment: BAILER
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$$150 - 69.58 = 80.42 \times 0.27 = 13.79 \text{ gal (1 CASING)} \times 2 = 27.49 \text{ gal (2 CASINGS)}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1055	BEGIN BAILING								69.58	—
1103	0.07	1	14.74	-17.5	9.92	6.68	576	5.24	—	—
1123	0.36	5	1.25	-9.9	9.06	6.77	571	10.53	—	—
1145	0.73	10	1.90	-16.3	9.51	6.90	589	12.4	—	—
1211	1.09	15	1.74	-81.2	9.48	6.35	623	34.0	—	—
1231	1.46	20	2.51	-69.2	9.07	6.73	583	25.0	—	—
1300	1.82	25	1.76	-66.7	9.13	6.74	551	16.8	—	—
1320	2.04	28	1.37	-34.4	9.25	6.87	527	16.8	—	—
1330	COLLECT FEW FEET MW60-146 - 16 FEET TOC									

Depth to water after purging/before sampling — ft TOC
 Sampling Equipment: DISPOSABLE BAILER

COMMENTS: PURGE WATER GRAY/ODOR, > 2 CASING VOLUMES

Analysis to be performed and Number of Containers:
 VOCs 3 Preservative HCl
RSK-175 3 Preservative HCl
CHLORIDE/SULFATE/ALK. Preservative 40C

Sampler Signature(s) [Signature]

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

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GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 11/7/20

Project No.: 606133342
 Field Crew: JMH, ME
 Weather: 56°F, cloudy

Analytical Instruments: pH: YSI 556
 Temp: ↓
 D.O.: ↓

Specific Conductivity: YSI 556
 ORP: ↓
 Turbidity: LaMotte 2020

Well ID: MW60-146
 Type of Well: nested monitoring
 Casing Stickup: 66.68' TOC
 Static Water Level: 66.68' TOC
 Well Depth/Diameter: 150' TOC / 2"

Purging Equipment: Disposable bailer
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$$150 - 66.68' = 83.32 \times 0.17 = 14.16 \text{ gallons} \times 2 = 28.32 \text{ gallons}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1054	Began	bailing well								
1115	0.28	4.0	2.89	-68.1	6.68	7.36	381	12.0	NA	N/A
1143		8.0	4.13	-99.4	6.96	7.31	380	70.5 AU		
1209	0.85	12.0	ME 4.20	-99.0	7.35	7.37	381	10 AU		
1240		16.0	3.72	-95.0	7.27	7.29	373	39.4		
1305	1.41	20.0	2.94	-90.2	6.85	7.24	352	37.5		
1325		24.0	3.51	-105.4	6.81	7.26	333	36.4		
1353	2.01	28.0	5.04	-86.9	6.73	7.30	329	50.7		
1358	collected sample		FFW4-MW60-146-P52B-4							

Depth to water after purging/before sampling NA ft TOC
 Sampling Equipment: Disposable bailer

COMMENTS: _____

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 RSK-175 3 Preservative HCl
 Chloride/Sulfate 3 Preservative 40C
 /ALK

Sampler Signature(s) Justin Humerick

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

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GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 6/27/20

Project No.: WS/316
 Field Crew: WS/316
 Weather: 70°F Cloudy

Analytical Instruments: pH: YSI 556
 Temp: ↓
 D.O: ↓

Specific Conductivity: YSI 556
 ORP: ↓
 Turbidity: LaMotte 2020we

Well ID: MW61-80
 Type of Well: MONITORING
 Casing Stickup: 78.38
 Static Water Level: 78.38
 Well Depth/Diameter: 88.3' TOC / 2" DIA

Purging Equipment: Redi-Flow
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$$88.3 - 78.38 = 9.92 \times 1.7 = 1.68 \times 2 = 3.36 \text{ g}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1643	Started Purging		10.32	173.8	10.75	7.18	314	1.4	78.38	
1646	1.19	2	7.36	118.4	10.21	5.75	318	1.4	80.23	.67
1649	2.38	4	7.82	116.4	10.31	7.83	317	11.2	80.5	.67
1651	3.57	6	8.42	96.7	10.33	5.86	316	9.6	80.7	1
1653	4.76	8	8.68	78.4	10.32	6.14	316	6.4	80.7	1
1655	5.95	10	8.82	64.2	10.32	6.38	316	5.8	80.7	1
1658	7.14	12	9.02	54.3	10.28	6.58	316	4.1	80.7	.67
1700	8.33	14	9.16	49.9	10.29	6.67	316	3.4	80.7	1
1702	9.52	16	9.21	46.7	10.36	6.73	316	2.8	80.6	1
1705	10.71	18	9.29	43.6	10.36	6.80	316	2.6	80.7	.67
1707	11.90	20	9.35	42.3	10.36	6.83	315	2.2	80.5	1
1708	Collected Sample	FEW4-MW61-80-15 for VOCs								

Depth to water after purging/before sampling 80.5' ft TOC
 Sampling Equipment: Redi-Flow & Discharge Tubing

COMMENTS: Shor! Water Column, Pump pulled only 2' from well bottom

Analysis to be performed and Number of Containers:
 VOCs 3 Preservative HCl
 Preservative
 Preservative

Sampler Signature(s) _____

Field Forms

Project Name: F.E. Warren Atlas Site 4
Site Name: Former Atlas D Missile Site 4
Sampling Date: 07/09/2020

Project No.: _____
Field Crew: HY, JM
Weather: SUNNY, 75°F, breezy

Analytical Instruments: pH: 7
Temp: 25
D.O: 1

Specific Conductivity: _____
ORP: _____
Turbidity: _____

Well ID: MW61-89
Type of Well: Monitoring - (nested)
Casing Stickup:
Static Water Level: 78.84' To
Well Depth/Diameter: 58.3' 2"

Purging Equipment: Disposable bailer

CASING VOLUME CALCULATION

$$(TD(ft) - DTW(ft)) \times \text{gal/ft} = 1 \text{ casing volume (gals)}$$

$$9.5' \times .17 = 1.65 \text{ gal}$$

[illegible]

Depth to water after purging/before sampling ~ 80' # TOC
Sampling Equipment: disposable bailer

COMMENTS:

Analysis to be performed and Number of Containers:

VOCs	_____	Preservative	_____
RSK-175	3	Preservative	HCl
Chloride/Sulfate	12	Preservative	4°C
Alkalinity	12	"	4°C

Sampler Signature(s) Ar. St. Thakur

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

Field Forms

Project No.: _____
Field Crew: JHMS
Weather: Cloudy/Hazy From Forrest Fire/smoke, 79°F

Specific Conductivity: $251-556 \mu$
ORP: _____
Turbidity: NA

Purging Equipment: Disposable Bailer
CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x ____ gal/ft = 1 casing volume (gals)
 8.69 X .17 = 1.5 gal

[illegible]

COMMENTS: 1218 - Begin boring
* Consecutive empty loggers pulled
Sediment / 2V1: preventing check-valve seq.

Sampler Signature(s) JH/

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GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 9-17-20

Project No.: 60613342
 Field Crew: JWK, JM
 Weather: 80°F SUNNY, SLIGHT BREEZE, HAZY

Analytical Instruments: pH: YSI 556
 Temp: " "
 D.O.: " "

Specific Conductivity: YSI 556
 ORP: " "
 Turbidity: - NA -

Well ID: MW61-80
 Type of Well: MONITORING WELL
 Casing Stickup: _____
 Static Water Level: 79.54 (TOC) 9-17-20
 Well Depth/Diameter: 88.3' / 2"

Purging Equipment: DISPOSABLE BAUER

CASING VOLUME CALCULATION

(TD(ft) - DTW(ft)) x ____ gal/ft = 1 casing volume (gals)

$$8.76 \times 0.17 = 1.49 \text{ gal.}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3% [µS/cm])	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1550	BEGIN BAILING									
1600		0.5	0.65	-130.4	10.34	8.36	625	cloudy, dark Gray		
1605		1.0	0.66	-137.2	9.69	8.32	636	" "		
1615		1.5	0.60	-147.4	9.67	8.41	523	" "		
1630		2.0	0.74	-143.1	9.62	8.54	527	" "		
1637		2.5	0.73	-139.6	9.59	8.40	539	" "		
1642		3.0	0.74	-136.0	9.43	8.41	527	" "		
1648	COLLECT SAMPLE		FEW4-MW61-80 - PS2A-3							

Depth to water after purging/before sampling _____ ft TOC _____

Sampling Equipment: DISPOSABLE BAUER

COMMENTS: 15 ft. SCREEN

Analysis to be performed and Number of Containers:

VOCs 3-40ml Preservative HCl + 4°C

RSK-175 3-40ml Preservative HCl + 4°C

Alkalinity 1-250 ml Preservative 4°C

Chloride/sulfate 1-125 ml 4°C

Sampler Signature(s) _____

[Signature]

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 10/20/2020

Project No.: 606133342
 Field Crew: JH
 Weather: SO.F. Cloudy. Very Windy w/ gusts 40mph

Analytical Instruments: pH: YSI 556
 Temp: ↓
 D.O: ↓

Specific Conductivity: YSI-556
 ORP: "
 Turbidity: -

Well ID: MW60-80-21 MW61-80
 Type of Well: monitoring
 Casing Stickup:
 Static Water Level: 79.35' TOC
 Well Depth/Diameter: 88.0' TOC / 2"

Purging Equipment: Disposable Bailor
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)
865' x .17 = 1.5 gal

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1006	Begin Bailing								-NA-	-NA-
1010		0.5	11.62	-42.7	7.02	6.83	463	Cloudy - grayish tint		
1017		1.0	5.02	-67.9	6.60	5.93	449	Cloudy / gray		
1022	1.0	1.5	3.31	-79.9	6.01	6.04	422	Cloudy / DK gray color		
1027		2.0	3.37	-74.6	6.32	6.01	418	"		
1031		2.5	3.29	-78.1	6.32	6.32	413	"		
1036	2.0	3.0	3.62	-79.8	6.30	6.22	407	"		
1043		3.5	3.87	-70.6	6.57	6.72	416	"		
1048	Collect Sample									

Depth to water after purging/before sampling ft TOC
 Sampling Equipment: DISPOSABLE BAILER

Analysis to be performed and Number of Containers:

VOCs 3-40ml Preservative HCL
 Alkalinity 1-250ml Preservative HCL
 Chloride/Sulfate 1-250ml Preservative 4°C

Pilot Test
 Post-Injection
 Performance Sampling
 Parameters

COMMENTS:
1037 - check pH reading w/ 7.0 pH Buffer solution;
pH reads 7.00
* pH readings were drifting - steady at 6.72 w/
3.0 gal purged

Sampler Signature(s) JH
 * Unable to use Flow Through cell b/c well is
 Bailer due to small water column; therefore
 Difficult to record stabilize parameters.
 achieve

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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ATTACHMENT 1

Field Forms

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 6/27/20

Project No.: WS/316
 Field Crew: WS/316
 Weather: 75°F, Cloudy

Analytical Instruments: pH: YSI 556
 Temp: ✓
 D.O: ✓

Specific Conductivity: YSI 556
 ORP: ✓
 Turbidity: LaMotte 2020w

80% Recovery
 $112.41 - 79.96' = 32.45'$
 $32.45 \times .8 = 26.0'$
 $112.41 - 26 = 86.41'$

Well ID: MW61-107
 Type of Well: MONITORING
 Casing Stickup: ✓
 Static Water Level: 79.96'
 Well Depth/Diameter: 112.41' TOC / 2" DIA

Purging Equipment: Rediflow
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$112.41' - 79.96' = 32.45' \times .17 = 5.5 \times 2 = 11 \text{ gal.}$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1521	Started	Purging	11.27	113.1	11.62	7.09	349	47	79.96	
1523		✓	7.81	122.2	10.13	7.96	345	19.4	89.4	0.3
1525		2	4.14	139.2	10.83	7.26	348	12.4	92.00	0.3
1528		3	1.4	90.1	11.61	7.23	348	13.5	92.8	.5
1530		4	0.97	28.5	12.05	6.33	351	14.6	92.9	0.5
1533		5	1.08	4.1	12.12	6.83	352	12.6	96.1	.3
1536		6	1.30	3.4	11.87	6.75	351	12.8	97.2	.2
1539		7	1.24	-3.7	12.21	6.90	352	10.5	97.2	.3
1542		8	1.18	-10.0	12.45	7.09	353	11.5	97.2	.3
1544		9	1.24	-10.0	12.49	7.12	354	8.6	97.2	.8
1546		10	1.34	-11.7	12.52	7.12	354	7.8	96.9	.5
1548		11	1.46	-10.1	12.52	7.08	354	7.2	96.95	.5
1549	Sampled	OK	REVIEW - MW61-107-15 for VOCs							

Depth to water after purging/before sampling 46.95' ft TOC

Sampling Equipment: Rediflow discharge tubing

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 Preservative
 Preservative

COMMENTS:

Sampler Signature(s) WS/316

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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ATTACHMENT 1

Field Forms

GROUNDWATER SAMPLING LOG (revised 8/17.2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 7/9/20
 Analytical Instruments: pH: YSI 556
 Temp: 4
 D.O.: 4

Project No.: 1M, MS
 Field Crew: Partly cloudy, 85°F, breeze
 Weather: YSI 556
 Specific Conductivity: "
 ORP: "
 Turbidity: "

Well ID: MW61-107
 Type of Well: Monitor
 Casing Stickup: "
 Static Water Level: 78.85
 Well Depth/Diameter: 112.4' x 2"

Purging Equipment: Redi-Flow
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$$33.5 \cdot 1.7 = 5.7 \text{ gal}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1422	Begin purging									
1424		2.0	3.8	49.0	10.3	6.02	375		95.09	
1426		4.0	1.2	47.7	11.2	6.24	379		102.0	
1442	WL = 83.81									
1443	Resume purging (de-aerated to check value @ 1426)									
1445	1.0	6.0	0.1	37.6	10.2	6.14	381		93.3	
1447		8.0	0.7	6.6	11.2	6.27	382		102.	
1448	Pause purging - de-aerated to check value.									
1458	WL = 83.98									
1500	Resume purging									
1502		10.0	1.5	30.9	10.4	6.07	382		99.26	
1504	Pause purging - de-aerated to check value.									
1516	WL = 84.71									
1518	2.1	12.0	1.7	25.3	9.6	6.06	379		93.13	

1520 Collect Sample FEW4-MW61-107-PS2A-1

Depth to water after purging/before sampling: ~100.0 ft TOC

Sampling Equipment: Collected from discharge tubing

COMMENTS:

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 RSK-175 3 Preservative 40C
 Chloride/sulfate 1 Preservative 40C
 Alkalinity 1 " 40C

Sampler Signature(s)

[Signature]

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

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ATTACHMENT 1

Field Forms

GROUNDWATER SAMPLING LOG (revised 8/17.2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 8/20/2020

Analytical Instruments: pH: YSI-556
 Temp: ↓
 D.O.: ↓

Well ID: MW101-107
 Type of Well: nestor monitoring well
 Casing Stickup: 80.28' TOC
 Well Depth/Diameter: 112.1' TOC

Project No.: JH, MS
 Field Crew: Cloudy/hazy from forest fires, 78°F
 Weather: Cloudy/hazy from forest fires, 78°F

Specific Conductivity: YSI-556
 ORP: "
 Turbidity: "

Purging Equipment: Disposable Bailer
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)
31.82' x 1.17 = 5.4 gal

Well Depth/Diameter: 112.1 100										
Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
0843	Begin Bailing	2	grayish	first w/ suspended particles	11.07	6.80	755	—	NA	NA
0854	0.7	4	5.49	-63.0	10.12	6.84	769	—		
0911	0.7	6	0.70	-145.6	11.04	7.15	740			
0924	1.5	8	6.60	-174.4	11.03	7.20	710			
0946		10	1.80	-173.5	11.80	7.24	681			
1002	2.03	11	0.61	-167.4						
1010	Collect	2 casing volumes Bailed								
1012		Sample #4 - MW101-107 - PSA-2								

Depth to water after purging/before sampling 91.30 ft TOC
 Sampling Equipment: Disposable Bailer

Analysis to be performed and Number of Containers:
 VOCs 3 Preservative HCL
 RSK-175 3 Preservative HCL
 Chloride/gal Intake Preservative —
 Alkalinity 1

COMMENTS: _____

 Sampler Signature(s) JH

GROUNDWATER SAMPLING LOG

Site Name: Former Atlas D Missile Site 4

Analytical Instruments: pH: 7.51 55-6

Temp: _____

D.O: _____

Well ID: MW61-107

Type of Well: _____

Casing Stickup: _____

Static Water Level: 80.3', TOC (9:17:20)

Well Depth/Diameter: 112.4/2"

Field Crew: LiK. - M

Weather: Sunny, 80°F, slight breeze, haze

Specific Conductivity: YSI 556

ORP: 4

Turbidity:

Purging Equipment: Disposable bailer

CASING VOLUME CALCULATION

$$(TD(ft) - DTW(ft)) \times \text{gal/ft} = 1 \text{ casing volume (gals)}$$
$$32.17 = 5.5 \text{ gal}$$
[illegible]

Sampling Equipment: biomass boiler

COMMENTS: 18" H screen

Analysis to be performed and Number of Containers:

VOCs 3-40m Preservative HCl

RSK-125 3.40m Preservative HCl

Alkalinity 1 (250 ml) Preservative 400

Sampler Signature(s) Joseph Mastromarino

chloride/sulfate 1 (125 ml) 4°C

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4

Site Name: Former Atlas D Missile Site 4

Sampling Date: 10/22/2020

Project No.: 606133342

Field Crew: ME, PG

Weather: 30° windy

Analytical Instruments: pH: YSI 556

Temp: "

D.O.: "

Specific Conductivity: YSI 556

ORP: "

Turbidity: Lamotte 2020

Well ID: MW61-107

Type of Well: monitoring well

Casing Stickup: "

Static Water Level: 80.28' TOC

Well Depth/Diameter: 112.1' TOC

Purging Equipment: Bladder pump w/ packer

CASING VOLUME CALCULATION

(TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

ME 10' x 16.5 = 6.5 gal

11' x 17 = 1.87 gal

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
<u>1130</u>	<u>Begin purging</u>									
<u>1253</u>	<u>1.3</u>	<u>2.5</u>	<u>7.3</u>	<u>-8.6</u>	<u>7.94</u>	<u>6.71</u>	<u>370</u>	<u>40.2</u>	<u>—</u>	<u>0.03</u>
<u>1305</u>	<u>1.3</u>	<u>3.5</u>	<u>7.3</u>	<u>-4.3</u>	<u>8.16</u>	<u>5.52</u>	<u>371</u>	<u>30.9</u>	<u>—</u>	<u>0.053</u>
<u>1322</u>	<u>2.36</u>	<u>4.5</u>	<u>6.1</u>	<u>-7.5</u>	<u>7.82</u>	<u>6.23</u>	<u>369</u>	<u>18.6</u>	<u>—</u>	<u>0.59</u>
<u>1340</u>	<u>2.89</u>	<u>5.5</u>	<u>5.4</u>	<u>-9.9</u>	<u>7.69</u>	<u>6.87</u>	<u>367</u>	<u>12</u>	<u>—</u>	<u>0.55</u>
<u>1352</u>	<u>3.16</u>	<u>6.0</u>	<u>0.24</u>	<u>-10.0</u>	<u>7.28</u>	<u>6.88</u>	<u>367</u>	<u>+40</u>	<u>—</u>	<u>0.42</u>
<u>1403</u>	<u>collected sample</u>									
<u>10/22/2020 ME</u>										

Depth to water after purging/before sampling ft TOC

Sampling Equipment: Bladder pump w/ packer

COMMENTS: refill 95 sec discharge 44 sec
pressure 45 psi

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
RSK-17.3 Preservative HCl
sulfate/chloride Preservative 4"
Alkalinity " "

Sampler Signature(s) Mike Easterday

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

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FEN4-MW⁶¹75-107-16
ME

ATTACHMENT 1

Field Forms

GROUNDWATER SAMPLING LOG (revised 8/17.2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 6/26/2020

Project No.: _____
 Field Crew: WSJK
 Weather: Sunny 70°F

$56.74 \times .8 = 45.39$
 $64.53 \times .8 = 51.62$

Analytical Instruments: pH: YSI Pro Plus
 Temp: ↓
 D.O: _____

Specific Conductivity: YSI Pro Plus
 ORP: _____
 Turbidity: LaMotte 2020 WA

Well ID: MW74-104
 Type of Well: Unvented Monitoring
 Casing Stickup: _____
 Static Water Level: 53.18
 Well Depth/Diameter: 109.92" TC/2"

Purging Equipment: RediFlo
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x _____ gal/ft = 1 casing volume (gals)

$(109.92 - 53.18) = 56.74 \times .17 = 9.64 \approx 19.29$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
0950	5.5	Pumping	8.56	124.3	8.31	7.00	262	12.5	53.18	WSJK
1005	1.5	5	1.37	99.5	9.31	5.78	265	17.9	69.20	.7
1014	1.0	16	0.98	73.0	9.58	6.94	266	11	73.50	.6
1019	1.6	15	0.95	63.9	9.03	6.51	263	7.2	80.00	1
1026	2.1	20	0.99	80.9	9.30	6.82	263	5.3	81.8	.7
1031	2.6	25	0.99	47.7	9.24	6.92	262	4.6	83.8	1
1034	2.9	27.5	1.04	49.6	9.21	6.88	262	5.0	86.6	.8
1035	Collected	sample for VOCs								

Depth to water after purging/before sampling 86.6' ft TOC _____
 Sampling Equipment: RediFlo & discharge tubing

COMMENTS: _____

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 _____ Preservative _____
 _____ Preservative _____

Sampler Signature(s) WSJK

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

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GROUNDWATER SAMPLING LOG (revised 8/17.2017)

Project Name: F.E. Warren Atlas Site 4Site Name: Former Atlas D Missile Site 4Sampling Date: 7/19/20Analytical Instruments: pH: YSI 556Temp: "D.O: "Well ID: MW74-104Type of Well: monitorCasing Stickup: Static Water Level: 52.22' TOC (7-19-20)Well Depth/Diameter: 109.8' / 2" TOCProject No.: 14. MSField Crew: Sunny, 80°F, slight breezeWeather: YSI 556Specific Conductivity: "ORP: "Turbidity: "Purging Equipment: RediFlo 2

CASING VOLUME CALCULATION

(TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$$53 \cdot 1.17 = 62 \text{ gal}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
0823	Begin	pumping								
0825		2.5	3.1	67.5	8.4	6.7	396	—	70.7	
0828		5.0	0.7	90.9	9.1	6.0	400	—	75.8	
0832		7.5	0.4	97.9	9.5	5.4	401	—	77.2	
0836		10.0	0.3	105.0	9.6	5.0	399	—	77.6	
0838		12.5	0.3	104.0	9.6	5.0	398	—	77.9	
0843		15.0	0.4	101.2	9.6	5.0	396	—	78.1	
0847		17.5	0.4	96.8	9.6	5.1	395	—	78.2	
0849	Collect Sample	FEW4-MW74-104-6PS2B-1 1-PS1-1 J.M.								

Depth to water after purging/before sampling: ~78.2 ft TOCSampling Equipment: Collected from discharge tubingCOMMENTS: purge water is very clear

Analysis to be performed and Number of Containers:

VOCs

Preservative

TAL Metals

Preservative

Preservative

HNO₃(HNO₃)₂SO₄+ NH₄OH before

Sampler Signature(s)

Joseph Martonovich

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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IF Purple
discuss next
YSI / & AB Acid
JOAS

DRUM
CK VALVE

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
Site Name: Former Atlas D Missile Site 4
Sampling Date: 9/24/2020

Project No.: 606133342
Field Crew: JH, AE
Weather: Sunny, Clear, Sl. Breeze 80°F

Analytical Instruments: pH: YSI-556
Temp:
D.O:
↓

Specific Conductivity: YSI-556
ORP:
Turbidity: LaMotte 2020we

Well ID: MW74-104
Type of Well: Nestro monitoring
Casing Stickup:
Static Water Level: 51.70' TOC
Well Depth/Diameter: 109.92' TOC / 2"

Purging Equipment: Grundfos Radi-Flu 2 pump
CASING VOLUME CALCULATION
(TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)
58.22' x 1.7 = 9.9 gal

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate (gpm)
1614	Begin purging		14.93	-30.7	11.02	7.70	398	37.3	61.12	
1624		3.31		-50.4	11.26	7.18	387	18.0	67.24	0.5
1634	Pause - 8m pumping									
1647	Resume pumping									
1648	0.0	8	2.21	-28.3	10.97	7.64	395	2739 AU	69.43	very cloudy
1652	- Stopped purging due to high turbidity									
1712	continued purging with bailer									
1723	1.2	12.0								
1802	1.6	16	10.42	-31.8	10.24	8.17	401	1043 AU	NA	NA - cloudy
1820	2.0	20	25.36	-47.1	8.90	7.82	400	1644 AU		
1839	Collected Samples									
FEW4-MW74-104-16										
ME										

Depth to water after purging before sampling: 62.82 ft TOC
Sampling Equipment: Bailer

COMMENTS: 1633 - turbidity is increasing - cloudy + flow is surging w/ very limited discharge - pump may be seizing
1647 - switch out pump controller's
1652 - Unable to increase flow rate + discharge to surface. Need to switch to a bailer

Analysis to be performed and Number of Containers:
VOCs 3 Preservative
Hexavalent Chromium Preservative
TAL Metals Preservative
+ Mercury
Ammonium Sulfate Buffer
Nitric Acid

Sampler Signature(s): 

Site-Wide UFP-QAPP
Former Atlas "D" Missile Site 4
F.E. Warren Air Force Base, Wyoming
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Note: The turbidity has increased significantly at this well interval, likely due to recent pneumatic injection activity of KMAD4 at injection point ~25' from MW74.

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 10/22/20

Project No.: 606133342
 Field Crew: JMA, TM
 Weather: 30°F, cloudy

Analytical Instruments: pH: YSI 556
 Temp: ↓
 D.O: ↓

Specific Conductivity: YSI 58
 ORP: ↓
 Turbidity: LaMotte 2020

Well ID: MW74-104
 Type of Well: monitoring
 Casing Stickup: 53.80' TOC
 Static Water Level: 109.92' TOC / 2"
 Well Depth/Diameter: 109.92' TOC / 2"

Purging Equipment: RediFlo II pump
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$$109.92 - 53.80 = 56.12 \times 0.17 = 9.54 \text{ gallons} \times 2 = 19.08 \text{ gallons}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1158	Begin purging		7.60	103.0	6.92	7.21	394	1.36	56.35'	
1201	0.21	2	2.38	49.6	8.27	7.30	388	30.0	62.90'	0.67
1204		4	1.91	54.7	8.51	7.52	387	57.7	69.51'	0.67
1206	0.63	6	1.75	58.2	8.99	7.51	386	—	72.36'	1.0
1208		8	1.58	58.0	8.99	7.56	387	56.0%	76.61'	1.0
1210	0.94	9	Stopped pumping due to questionable turbidity + surging pump							
1250	Continue Purging with Bailor									
1304	1.26	12	8.04	36.5	7.23	7.61	398	51.0	NA	NA
1316	1.57	15	6.55	36.1	6.83	7.47	383	1412 AU	NA	NA
1330	1.87	18	3.96	39.4	6.67	7.63	395	1342 AU	NA	NA
1340	2.1	20	2.87	70.2	6.65	7.65	376	917 AU	68.02	NA
1350	Collect sample FEW74-MW74-104-PS1-3 for Hexavalent Chromium, TAL Metals + Mercury									

Depth to water after purging/before sampling 68.02' ft TOC
 Sampling Equipment: DISPOSABLE BAILOR

COMMENTS: * Turbidity numbers were not confident
1210 = turbidity is increasingly cloudier; the flow surges
can't measure flow rate / discharge

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCL
~~Hexavalent Chromium~~ Preservative ~~Ammonium Sulfate Buffer~~
TAL METALS + Mercury Preservative NITRIC ACID

Sampler Signature(s) Justin Hummer

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

W912DY-16-D-0026, TO W9128F19F0192

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GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 12/5/20

Project No.: _____
 Field Crew: JH, PM
 Weather: Sunny/Clear, St. Breeze, 45°F

Analytical Instruments: pH: YSI Pro Plus
 Temp: _____
 D.O.: _____

Specific Conductivity: YSI Pro Plus
 ORP: _____
 Turbidity: HACH 2100 Q

Well ID: MW74-104
 Type of Well: Nested Monitor
 Casing Stickup: _____
 Static Water Level: 52.79' TOC
 Well Depth/Diameter: 109.5' TOC / 2"

Purging Equipment: Grundfos Redi-Flt 2 pump

CASING VOLUME CALCULATION

(TD(ft) - DTW(ft)) x _____ gal/ft = 1 casing volume (gals)

$$56.71 \times 0.17 = 9.6 \text{ gal}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate (gpm)
1337	Begin purging	2	2.26	-23.1	7.0	7.51	367.0	252	61.55	
1338		3	0.32	-42.0	8.0	7.00	346.1	144	64.55	
1342		4	0.21	-64.7	9.0	7.47	351.1	389	72.71	0.5
1344		6	0.27	-75.0	8.6	7.73	328.4	256	80.16	1.0
1348	0.8	8	0.25	-80	8.6	7.78	347.1	907	83.98	
1350		9	- increase in turbidity; pump is boozing up + discharge is surging							
1403	Continue purging w/ disposable bailer	11	4.12	-38.9	8.1	7.78	361.0	354	NA	-NA-
1414		13	2.62	-28.6	7.7	7.75	354.0	657		
1422	1.6	15	2.86	-46.4	7.4	7.74	344.5	805		
1432		17	2.96	-32.3	7.4	7.70	342.6	417		
1440		19	2.58	-33.9	7.2	7.65	343.5	385		
1451	2.1	20	Collect sample FEW 4-MW74-104 #6 PSI-4							

Depth to water after purging/before sampling _____ ft TOC

Sampling Equipment: Redi-Flt 2 pump Disposable Bailer

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCL
TAL Metals + Hg Preservative Nitric Acid
 Preservative _____

COMMENTS: pilot study post-injection performance sample

Sampler Signature(s) JH

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 05/30/2020

Project No.: _____
 Field Crew: 47/38A
 Weather: overcast, breezy, 70s

Analytical Instruments: pH: 751 556
 Temp: "
 D.O: "

Specific Conductivity: 751 556
 ORP: "
 Turbidity: LaMotte 2020

Well ID: MW75-93
 Type of Well: Unsted monitoring
 Casing Stickup: _____
 Static Water Level: 78.55' Tol
 Well Depth/Diameter: 92.84' Tol / 2"

Purging Equipment: Red Flo 2
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x _____ gal/ft = 1 casing volume (gals)

$$97.84 - 78.55 = 19.29 \times 0.17 = 3.3 \text{ gal} = 1 \text{ casing}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1403	Begin purging									
1405	0.1	0.2	10.12	6.59	10.25	6.50	0.361	6.30	82.95	1
1409	1.2	4	10.03	-19.0	10.41	6.10	0.361	3.78	83.09	0.5
1412	1.8	6	9.93	-21.4	10.72	6.38	0.360	3.03	82.65	0.67
1416	2.4	8	9.93	-25.9	10.78	6.60	0.360	2.69	82.58	0.5
1419	3.0	10	9.86	-27.1	10.79	6.72	0.360	3.35	82.52	0.67
1422	3.6	12	9.99	-26.4	10.79	6.82	0.361	2.99	82.60	0.67
1425	4.2	14	10.03	-24.8	10.79	6.80	0.361	3.32	82.60	0.67
1428	Collect sample from MW75-93-15 for use									

Depth to water after purging/before sampling 82.60 ft TOC

Sampling Equipment: Red Flo 2 + dedicated tubing

COMMENTS: > 2 casings purged + all parameters stable
for three consecutive readings

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 _____ Preservative _____
 _____ Preservative _____

Sampler Signature(s) Halle

Site-Wide UFP-QAPP

Former Atlas "D" Missile Site 4

F.E. Warren Air Force Base, Wyoming

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ATTACHMENT 1

Field Forms

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 7/9/20
 Analytical Instruments: pH: YSI 556
 Temp: 4
 D.O.: 11

Project No.: 1M, MS
 Field Crew: Sunny, 85°F, breeze
 Weather: YSI 556
 Specific Conductivity: YSI 556
 ORP: 11
 Turbidity: 11

Well ID: MW75-93
 Type of Well: 1
 Casing Stickup: 78.5' TOC
 Static Water Level: 98' TOC/21
 Well Depth/Diameter: 98' TOC/21

Purging Equipment: Radi-Fl 2
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)
20.5 x .17 = 3.5 gal

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1615	Begin purging									
1616	1.0	1.0	8.5	31.7	10.7	5.6	348	—	86.1	
1617	Pause - de-water to check valve.									
1629	Resume purging									
1630	1.0	3.0	8.3	102.8	11.7	5.97	349	—	85.0	
1631	1.0	4.5	7.9	91.9	11.2	6.1	347	—	85.8	
1633		6.0	7.8	85.2	11.0	5.9	346	—	87.0	
1637	Resume purging									
1638	2.0	7.0	8.1	80.2	11.0	5.64	347	—	85.0	
1640		8.0	7.7	78.6	10.6	5.73	346	—	85.1	
1645	Collect Sample									

Depth to water after purging/before sampling ~85 ft TOC
 Sampling Equipment: Collected from discharge tubing

COMMENTS: Purge water is very clear

Analysis to be performed and Number of Containers:
 VOCs 3 Preservative HCl
 Sulfide 1 Preservative 4°C
 Alkalinity 1 Preservative 4°C

Sampler Signature(s) [Signature]

Site-Wide UFP-QAPP
 Former Atlas "D" Missile Site 4
 F.E. Warren Air Force Base, Wyoming
 W912DY-16-D-0026, TO W9128F19F0192

GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 8/21/20

Analytical Instruments: pH: YSI 556
 Temp: "
 D.O.: "

Well ID: MW75-93
 Type of Well:
 Casing Stickup:
 Static Water Level: 78.32' TOC 8/21/20
 Well Depth/Diameter: 98.1/2"

Project No.:
 Field Crew: J.M. MS
 Weather: Sunny, 85°F, breezy
 Specific Conductivity: YSI 556
 ORP: "
 Turbidity: —

Purging Equipment: Redi-Flow 2
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)

$$20' \cdot .17 = 3.4 \text{ gal.}$$

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3% [µS/cm])	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1343	Begin purging									
1345		2.0	4.3	81.7	11.1	6.94	371	light gray	86.1	
1346	- Pump off - de-aerated to pump.									
1357	Resume	4.0	4.85	85.3	10.80	7.2	379		82.3	
1401		6.0	4.43	92.2	10.72	7.06	371	slightly turbid	87.2	
1402	- Pump off - de-aerated to pump									
1403	Resume									
1410		8.0	4.64	75.8	10.78	7.21	374	clear	83.4	
1411	Pump off									
1416	Pump on - Collect Sample FEW4-MW75-93-PS2A-2									

Depth to water after purging/before sampling ~82 ft TOC

Sampling Equipment: Collected from discharge tubing

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
 RSK-175 3 Preservative HCl
 Sulfate/chloride 1 Preservative 4°C
 Alkalinity 1 " " "

COMMENTS:

Sampler Signature(s)

Joseph Mastromarino

GROUNDWATER SAMPLING LOG

Project Name: Atlas Site 4 LTMP
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 9/18/20
 Analytical Instruments: pH: YSI 556
 Temp: "
 D.O: "

Project No.: 60613342
 Field Crew: LSK, JM
 Weather: Sunny, 72°F, breeze, hazy
 Specific Conductivity: YSI 556
 ORP: "
 Turbidity: —

Well ID: MW 75-93
 Type of Well: Monitoring
 Casing Stickup: 78.72' TOC (9.18-20)
 Static Water Level: 98.14' 2"
 Well Depth/Diameter: 98.14' 2"

Purging Equipment: Disposable bailer
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)
20 - 17 = 3.4 gal

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3% [µS/cm])	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1100	Begin purging									
1105		1.05	7.6	44.2	9.3	9.5*	348	slightly cloudy		
1117		2.5	7.4	98.2	9.8	7.3	353	"		
1125		3.75	7.8	69.12-22M	10.2	7.3	352	"		
1129		5.0	7.6	65.2	9.6	7.4	350	"		
1133		5.75	7.7	65.4	9.5	7.5	352	"		
1136		6.5	7.6	64.1	9.4	7.5	353	"		
1139		7.25	7.6	63.9	9.6	7.6	350	"		
1145	Collect sample FEW4-MW75-93-PS2A-3									

Depth to water after purging/before sampling 78.87' ft TOC
 Sampling Equipment: disposable bailer

COMMENTS: * - pH calibration was off; recalibrated sensor

Analysis to be performed and Number of Containers:

VOCs 3 Preservative HCl
RSK-175 3 Preservative HCl
chloride/sulfate 1 Preservative 4°C
Alkalinity 1 4°C

Sampler Signature(s) [Signature]

GROUNDWATER SAMPLING LOG (revised 8/17/2017)

Project Name: F.E. Warren Atlas Site 4
 Site Name: Former Atlas D Missile Site 4
 Sampling Date: 10/22/2020

Project No.: 606133342
 Field Crew: ME, PG
 Weather: 26° F, windy

Analytical Instruments: pH: YSI 556
 Temp: "
 D.O.: "

Specific Conductivity: YSI 556
 ORP: "
 Turbidity: Lamotte

Well ID: MW75-93
 Type of Well: monitoring well
 Casing Stickup: 78.32' TOC
 Static Water Level: 98.1' TOC / 2"
 Well Depth/Diameter: 98.1' TOC / 2"

Purging Equipment: Bladder pump w/ packer
 CASING VOLUME CALCULATION
 (TD(ft) - DTW(ft)) x gal/ft = 1 casing volume (gals)
20' x .17 = 3.4 gal

Time	Casing Volumes	Gallons Removed	D.O. (±0.5 mg/l)	ORP (±10 mV)	Temp (±1°C)	pH (±0.1)	Sp. Cond. (±3 µS)	Turbidity (± 10% NTUs)	PWL (ft TOC)	Purge Rate
1538	Begin purging									
1551	0.31	1.28	5.83	118.7	7.51	5.72	316	17.2	—	0.096
1604	0.59	2.00	6.41	518.7	7.24	4.85	315	11.6	—	0.058
1637	1.18	4	9.05	13.3	7.31	9.02	306	4.7	—	0.061
1651	1.47	5	7.26	14.2	7.13	6.97	306	3.75	—	0.071
1707	1.76	6	7.11	14.3	7.11	6.88	306	3.69	—	0.063
1724	2.05	7	6.98	13.7	6.76	6.87	307	3.02	—	0.059
1725	collected sample									
10/22/2020 ME										

Depth to water after purging/before sampling — ft TOC
 Sampling Equipment: Bladder Pump

COMMENTS:

Analysis to be performed and Number of Containers:
 VOCs 3 Preservative HCl
RSK-175-3 Preservative HCl
Sulfate/chloride Preservative 4°C
Alkalinity " "

Sampler Signature(s) Nike Easton

FEW4-MW75-93-16

Site-Wide UFP-QAPP
 Former Atlas "D" Missile Site 4
 F.E. Warren Air Force Base, Wyoming
 W912DY-16-D-0026, TO W9128F19F0192

PROJECT NAME:	Atlas D Missile Site 4 PS	Date:	9/1/2020
Location:	Cheyenne, Wyoming	Weather:	Cloudy, 65°F, 10 mph S wind
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company	FIELD INSTALLATIONS: ID Nos.	Drilled From:	Drilled To:
Jon Kinkade	URS			
Jake Kokesh	URS			
Gilbert Lozano	Yellow Jacket			
William Blair	Yellow Jacket			
Carlos Hernandez	Yellow Jacket			
Joe Mastromarchi	Na Ali'i			

EQUIPMENT:

Description	Description	ENVIRONMENTAL SAMPLES COLLECTED: Sample ID Nos.	Analytes
ChemGrout CG-680 Mixer	(2) USS Porto Potties	FEW4-MW60-146	8260C, RSK-175, Cl/SO4/alk
EZ LOAD 2500 Hopper	URS Rental Vehicle	FEW4-IDW-INF	8260C
21,000 gal Frac Tank	Yellow Jacket Drill Rig	FEW4-IDW-INT	8260C
6,900 gal IDW Tank	Yellow Jacket Company Truck	FEW4-IDW-EFF	8260C
(2) Genie GTH-5519 Forklift	Yellow Jacket Equipment Truck		
Soil Hopper	Yellow Jacket Water Truck		
(18) 25 kg Guar Gum Bags	Na Ali'i Company Van		
Generator	Rolloff Dumpster		
Eye Wash Station			

Brief Description of Work Performed:

Continued drilling MW106 to 188 ft bgs for MW106. Treated IDW water with GAC system. Continued developing MW104.
Collected GAC water samples. Bailed and sampled MW60-146
Yellow Jacket personnel demobilized around 1100.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Jake Kokesh

PROJECT NAME: Atlas D Missile Site 4 LTMP
Location: Cheyenne, Wyoming
USACE PM: Jeff Gill
URS Project No.: 60613342

Date: 12/2/2020
Weather: Sunny, high winds in the a.m. 21-25°F
URS PM: Robert Mallisee
Contract/DO: W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Jen Hussey	Na Ali'i
Holly Young	Na Ali'i

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
NA		

EQUIPMENT:

Description	License No.
300-ft Water Level Meter	
500-ft Water Level Meter	
YSI Professional Plus	
Hach 2100Q Turbidity Meter	
Disposable Bailer	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW-MW59-74-PS1-4	TAL Metals, mercury
FEW4-MW92B-288-16	VOCs, 8260

Brief Description of Work Performed:

Met Steil Surveying onsite to show well locations for surveying MW84B, MW92B, MW104, and MW106.
Collected one groundwater sample from MW92B and a post-injection monthly performance sample from MW59-74.
Due to the presence of potassium permanganate in groundwater purged from MW59-74, sample will be submitted for TAL metals and mercury analysis only. Went to Home Depot to pick up fittings to reassemble GAC system.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Jennifer Hussey

PROJECT NAME:

Atlas D Missile Site 4 PS

Location:

Cheyenne, Wyoming

USACE PM:

Jeff Gill

URS Project No.:

60613342

Date:

9/2/2020

Weather:

Clear, 865°F, 10 mph S wind

URS PM:

Robert Mallisee

Contract/DO:

W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Jon Kinkade	URS
Jake Kokesh	URS
Joe Mastromarchi	Na Ali'i

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:

EQUIPMENT:

Description	Description
ChemGrout CG-680 Mixer	(2) USS Porto Potties
EZ LOAD 2500 Hopper	URS Rental Vehicle
21,000 gal Frac Tank	Yellow Jacket Drill Rig
6,900 gal IDW Tank	Yellow Jacket Company Truck
(2) Genie GTH-5519 Forklift	Yellow Jacket Equipment Truck
Soil Hopper	Yellow Jacket Water Truck
(18) 25 kg Guar Gum Bags	Na Ali'i Company Van
Generator	Rolloff Dumpster
Eye Wash Station	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW60-90	8260C, RSK-175, Cl/SO4/Alk

Brief Description of Work Performed:

Surveyed injection points, sampled MW60-90, Pumped MW104, prepared injection IDW for transport

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature:

Jake Kokesh

PROJECT NAME: Atlas D Missile Site 4 LTMP
Location: Cheyenne, Wyoming
USACE PM: Jeff Gill
URS Project No.: 60613342

Date: 12/5/2020
Weather: Sunny/clear, breezy. Mid 40's°F
URS PM: Robert Mallisee
Contract/DO: W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Jen Hussey	Na Ali'i
Patrick Gronewoller	Na Ali'i

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
NA		

EQUIPMENT:

Description	License No.
300-ft Water Level Meter	
500-ft Water Level Meter	
YSI Professional Plus	
Grundfos Redi-Flo 2 pump and controller	
Hach 2100Q Turbidity Meter	
Generator	
disposable bailer	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW84B-143-16	VOCs, 8260
FEW4-MW84B-193-16	VOCs, 8260
FEW4-MW84B-193-MS-16	VOCs, 8260
FEW4-MW84B-193-MSD-16	VOCs, 8260
FEW4-MW104-99-16	VOCs, 8260
FEW4-MW74-104-PS1-4	VOCs,TAL Metals,Mercury

Brief Description of Work Performed:

Finished collecting groundwater samples at the newly installed DGI monitoring wells. All sampling for the fall 2020 LTM event has been completed. Collected pilot study post-injection monthly performance sample from MW74-104.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

None.

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Jennifer Hussey

PROJECT NAME: Atlas D Missile Site 4 LTMP
Location: Cheyenne, Wyoming
USACE PM: Jeff Gill
URS Project No.: 60613342

Date: 12/6/2020
Weather: Sunny/clear, windy, Mid 40's°F
URS PM: Robert Mallisee
Contract/DO: W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Jen Hussey	Na Ali'i
Patrick Gronewoller	Na Ali'i

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
NA		

EQUIPMENT:

Description	License No.
300-ft Water Level Meter	
500-ft Water Level Meter	
YSI Professional Plus	
Grundfos Redi-Flo 2 pump and controller	
Hach 2100Q Turbidity Meter	
Generator	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW59-125-PS1-4	VOCs,TAL Metals,Mercury

Brief Description of Work Performed:

Collected pilot study post-injection performance sample from MW59-125.

Treated purge water with mobile GAC system. Mob off-site. Samples collected over weekend will be shipped to APPL on Monday.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

None.

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Jennifer Hussey

PROJECT NAME:	<u>Atlas D Missile Site 4 LTMP</u>	Date:	<u>11/7/2020</u>
Location:	<u>Cheyenne, Wyoming</u>	Weather:	<u>Clear, 55°F, 15 mph W wind</u>
USACE PM:	<u>Jeff Gill</u>	URS PM:	<u>Robert Mallisee</u>
URS Project No.:	<u>60613342</u>	Contract/DO:	<u>W912DY-16-D-0026/W9128F19F0192</u>

PERSONNEL:

Name	Company
<u>Mike Easterday</u>	<u>URS</u>
<u>Justin Humenik</u>	<u>URS</u>
<u>Isaac Knutson</u>	<u>URS</u>
<u>Jennifer Hussey</u>	<u>Na Ali'i</u>
<u>Holly Young</u>	<u>Na Ali'i</u>
<u>Patrick G.</u>	<u>Na Ali'i</u>

FIELD INSTALLATIONS:

ID Nos.	Drilled From	Drilled To:
<u>NA</u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>

EQUIPMENT:

Description	License No.
<u>(2) 300-ft Water Level Meter</u>	<u></u>
<u>500-ft Water Level Meter</u>	<u></u>
<u>(4) YSI 556</u>	<u></u>
<u>(8) Grundfos - Redi-Flo 2" pump</u>	<u></u>
<u>(3) Grundfos - Redi-Flo 2" Converter Box</u>	<u></u>
<u>(3) LaMotte - 2020we Turbidity Meter</u>	<u></u>
<u>QED - MP10H Bladder Pump Controller</u>	<u></u>
<u>(3) Generators</u>	<u></u>
<u>Bladder Pump w/ packer</u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
<u>FEW4-MW24-16</u>	<u>VOCs, 8260</u>
<u>FEW4-MW60-90-16</u>	<u>VOCs, 8260</u>
<u>FEW4-MW60-146-16</u>	<u>VOCs, 8260</u>
<u>FEW4-MW66-158-16</u>	<u>VOCs, 8260</u>
<u>FEW4-MW80-223-16</u>	<u>VOCs, 8260</u>
<u>FEW4-MW104-135-16</u>	<u>VOCs, 8260</u>
<u>FEW4-MW104-178-16</u>	<u>VOCs, 8260</u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>

Brief Description of Work Performed:

Collected 7 groundwater samples

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Mike Easterday

Date: 7/9/2020
Weather: Sunny, 82°F
URS PM: Robert Mallisee
Contract/DO: W912DY-16-D-0026/W9128F19F0192

FIELD INSTALLATIONS:

[illegible]

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW61-80-15	MEE, RSK 175
	Chloride/Sulfate, 9056A
	Alkalinity, SM2320B
FEW4-MW61-107-15	MEE, RSK 175
Truck	Chloride/Sulfate, 9056A
	Alkalinity, SM2320B
FEW4-MW75-93-15	MEE, RSK 175
	Chloride/Sulfate, 9056A
	Alkalinity, SM2320B

Met with members of Na Ali'i, Yellow Jacket Drilling, Redox Tech and Hepure at site to go over safety meeting and plans.
Redox Tech and Hepure had an additional meeting later to go over injection health and safety. Drilled IP09 from 44 ft bgs to 85 ft bgs.
Placed PVC temporary well casing in borehole to be grouted tomorrow. Collected groundwater samples for methane, ethane, ethene, chloride, sulfate, and alkalinity analysis in MW61-80, MW61-107, and MW75-93.

Level D, Daily Safety Tailgate Meeting

Changes from Workplan:

The drilling log for MW61 included a sand layer from 80 to 82 ft bgs and the drilling log for MW75 included sand layers from 75 to 78 ft bgs and from 82 to 84 ft bgs. Based on these observations, there is a sand layer within the designed injection interval of IP07, IP08, and IP09 which would likely compromise the borehole and disallow injections if not sealed through the entire Ogallala Formation and slightly within the White River Formation to 85 ft bgs. The casing for IP09 was drilled to 85 ft bgs for this reason.

Delivery of compressed nitrogen tanks (12) and fracturing module.

Signature: Matthew Schmit

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	7/10/2020
Location:	Cheyenne, Wyoming	Weather:	Sunny, 95°F
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Matthew Schmit	URS
Stephen Heinicke	URS
Joe Mastromarchi	Na Ali'i
Cody Gabala	Yellow Jacket
Omar Lopez	Yellow Jacket
Tristan Truax	Yellow Jacket

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
IP08	0 ft bgs	36 ft bgs

EQUIPMENT:

Description	Description
MiniRAE 3000 PID	(2) Generators
ChemGrout CG-680 Mixer	Eye Wash Station
EZ LOAD 2500 Hopper	(2) USS Porto Potties
21,000 gal Frac Tank	(2) URS Rental Vehicles
6,900 gal IDW Tank	Yellow Jacket Drill Rig
(2) Genie GTH-5519 Forklift	(2) Yellow Jacket Company Trucks
Soil Hopper	Yellow Jacket Equipment Truck
Compressed Nitrogen Trailer	Yellow Jacket Water Truck
Compressed Nitrogen Tanks	Na Ali'i Company Van
(28) 2,500 lb ZVI Super Sacs	Redox Tech Trailer
(27) 25 kg Guar Gum Bags	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW60-90-PS2B-1	MEE, RSK 175
	Chloride/Sulfate, 9056A
	Alkalinity, SM2320B
FEW4-MW60-146-PS2B-1	MEE, RSK 175
	Chloride/Sulfate, 9056A
	Alkalinity, SM2320B

Brief Description of Work Performed:

Met with members of Na Ali'i and Yellow Jacket Drilling at site to go over safety meeting and plans. Placed and grouted PVC temporary well casing in borehole. Drilled IP08 from 0 ft bgs to 36 ft bgs. Collected groundwater samples for methane, ethane, ethene, chloride, sulfate, and alkalinity analysis in MW60-90 and MW60-146. Shipped samples from 7/9/20 and 7/10/20 to APPL labs via Fedex for Saturday delivery. Received water delivery for Frac Tank.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

Delivery of water for Frac Tank.

Signature: Matthew Schmit

PROJECT NAME:	Atlas D Missile Site 4 LTM	Date:	10/12/2020
Location:	Cheyenne, Wyoming	Weather:	
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Mike Easterday	URS
Isaac Knutson	URS
Justin Humenik	URS
Jake Kokesh	URS
Jennifer Hussey	Na Ali'i
Joe Mastromarchi	Na Ali'i
Todd Marguiles	Na Ali'i
James	TriHydro

FIELD INSTALLATIONS:

ID Nos.	Drilled From	Drilled To:

EQUIPMENT:

Description	License No.
(2) 300-ft Water Level Meter	
500-ft Water Level Meter	
(4) YSI 556	
(8) Grundfos - Redi-Flo 2" pump	
(3) Grundfos - Redi-Flo 2" Converter Box	
(3) LaMotte - 2020we Turbidity Meter	
QED - MP10H Bladder Pump Controller	
(3) Generators	
Bladder Pump w/ packer	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW20-16	VOCs, 8260
FEW4-MW20-FD-16	VOCs, 8260
FEW4-MW69-99-16	VOCs, 8260
FEW4-MW77-255-16	VOCs, 8260
FEW4-MW77-40-16	VOCs, 8260
FEW4-MW77-40-FD-16	VOCs, 8260
FEW4-MW89-207-16	VOCs, 8260
FEW4-TB10-16	VOCs, 8260
FEW4-TH6-197-16	VOCs, 8260
FEW4-TH6-234-16	VOCs, 8260
FEW4-TH6-234-FD-16	VOCs, 8260

Brief Description of Work Performed:

Collected 7 groundwater samples.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature:

Mike Easterday

PROJECT NAME:	Atlas D Missile Site 4 DGI	Date:	9/18/2020
Location:	Cheyenne, Wyoming	Weather:	Sunny, 75°F, 15 mph S wind
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Jon Kinkade	URS
Jake Kokesh	URS
Jen Hussey	Na Ali'i
Carlos Hernandez	Yellow Jacket
Matt Sheffer	Yellow Jacket
Arthur Guetsia	Yellow Jacket
Mark Williams	Yellow Jacket

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
FEW4-MW92B	216 ft bgs	336 ft bgs

EQUIPMENT:

Description	Description
ChemGrout CG-680 Mixer	(2) USS Porto Potties
EZ LOAD 2500 Hopper	URS Rental Vehicle
21,000 gal Frac Tank	Yellow Jacket Drill Rig
6,900 gal IDW Tank	(2) Yellow Jacket Company
(2) Genie GTH-5519 Forklift	Yellow Jacket Equipment Truck
Soil Hopper	Yellow Jacket Water Truck
(18) 25 kg Guar Gum Bags	Na Ali'i Company Van
Generator	Roll off Dumpster
Eye Wash Station	Tulsa Rig Iron Mud System

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW106-TEMP	8260C
FEW4-IDW-INT	8260C
FEW4-IDW-EFF	8260C
FEW4-MW75-93-PS2A-3	8260C, RSK-175

Brief Description of Work Performed:

Finished drilling MW92B to 336' bgs. Developed MW106. Collected MW75 groundwater performance sample, MW106 development water sample, and IDW samples.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Jake Kokesh

PROJECT NAME:	<u>Atlas D Missile Site 4 PS</u>	Date:	<u>7/19/2020</u>
Location:	<u>Cheyenne, Wyoming</u>	Weather:	<u>86°F, 11 mph SW wind, afternoon thunderstorms</u>
USACE PM:	<u>Jeff Gill</u>	URS PM:	<u>Robert Mallisee</u>
URS Project No.:	<u>60613342</u>	Contract/DO:	<u>W912DY-16-D-0026/W9128F19F0192</u>

PERSONNEL:

Name	Company
<u>Stephen Heinicke</u>	<u>URS</u>
<u>Matthew Schmit</u>	<u>URS</u>
<u>Chris Lacko</u>	<u>Redox Tech</u>
<u>Mike Clark</u>	<u>Redox Tech</u>
<u>Joe Mastromarchi</u>	<u>Na Ali'i</u>
<u>Chris Hill</u>	<u>Yellow Jacket</u>
<u>Diego Diaz</u>	<u>Yellow Jacket</u>
<u>Roger Rubio</u>	<u>Yellow Jacket</u>
<u>Jen Hussey</u>	<u>Na Ali'i</u>

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
<u>IP04</u>	<u>0 ft bgs</u>	<u>5 ft bgs</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
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<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

EQUIPMENT:

Description	Description
<u>MiniRAE 3000 PID</u>	<u>(27) 25 kg Guar Gum Bags</u>
<u>ChemGrout CG-680 Mixer</u>	<u>(76) Barrels KMnO4</u>
<u>EZ LOAD 2500 Hopper</u>	<u>(2) Generators</u>
<u>21,000 gal Frac Tank</u>	<u>(2) Eye Wash Stations</u>
<u>6,900 gal IDW Tank</u>	<u>(2) USS Porto Potties</u>
<u>(2) Genie GTH-5519 Forklift</u>	<u>(2) URS Rental Vehicles</u>
<u>Soil Hopper</u>	<u>Yellow Jacket Drill Rig</u>
<u>Compressed Nitrogen Trailer</u>	<u>(2) Yellow Jacket Company Trucks</u>
<u>Compressed Nitrogen Tanks</u>	<u>Yellow Jacket Equipment Truck</u>
<u>Pressure Regulator</u>	<u>Yellow Jacket Water Truck</u>
<u>(4) Borehole Packers</u>	<u>Na Ali'i Company Van</u>
<u>(3) MW Packers</u>	<u>Redox Tech Trailer</u>
<u>(28) 2,500 lb ZVI Super Sacs</u>	<u>Rolloff Dumpster</u>

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
<u>FEW4-MW74-104-PS1-1</u>	<u>TAL Metals, 6020B/7470A</u>
<u> </u>	<u>Hexavalent Chromium, 218.7</u>
<u>FEW4-MW59-125-PS1-1</u>	<u>TAL Metals, 6020B/7470A</u>
<u> </u>	<u>Hexavalent Chromium, 218.7</u>
<u>FEW4-MW59-74-PS1-1</u>	<u>TAL Metals, 6020B/7470A</u>
<u> </u>	<u>Hexavalent Chromium, 218.7</u>
<u> </u>	<u> </u>
<u> </u>	<u> </u>
<u> </u>	<u> </u>
<u> </u>	<u> </u>
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<u> </u>	<u> </u>
<u> </u>	<u> </u>

Brief Description of Work Performed:

Met with members of Na Ali'i, Redox, and Yellow Jacket Drilling at site to go over safety meeting and plans. Injected IP09 95 to 100 ft bgs interval with 2,400 lbs ZVI, 3,855 lbs water, and 18 pounds guar. Injected IP09 90 to 95 ft bgs interval with 1,200 lbs ZVI, 1,928 lbs water, and 9 lbs guar. Injected IP09 85 to 90 ft bgs interval with 2,000 lbs ZVI, 3,213 lbs water, and 15 lbs guar. Grouted IP09 upon completion of injections. Sampled the following monitoring wells for TAL Metals and Hexavalent Chromium at MW74-104, MW59-125, and MW59-74 for baseline parameters. Set up and drilled IP04 from 0 ft bgs to 5 ft bgs.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

Began drilling IP04 at a 13 degree angle.

Remarks/Visitors:

Doubled injectant for IP09 95 to 100 ft bgs interval to account for uninjected material at IP07. Additional 2/3 of a full batch of injectant in IP09 85 to 90 ft bgs interval to account for uninjected material at IP08.

Signature: Matthew Schmit

PROJECT NAME:	<u>Atlas D Missile Site 4 PS</u>	Date:	<u>8/20/2020</u>
Location:	<u>Cheyenne, Wyoming</u>	Weather:	<u>Sunny, 82°F, 10 mph N wind, afternoon thunderstorms</u>
USACE PM:	<u>Jeff Gill</u>	URS PM:	<u>Robert Mallisee</u>
URS Project No.:	<u>60613342</u>	Contract/DO:	<u>W912DY-16-D-0026/W9128F19F0192</u>

PERSONNEL:

Name	Company
<u>Matthew Schmit</u>	<u>URS</u>
<u>Stephen Heinicke</u>	<u>URS</u>
<u>Gilbert Lozano</u>	<u>Yellow Jacket</u>
<u>William Blair</u>	<u>Yellow Jacket</u>
<u>Chris Hill</u>	<u>Yellow Jacket</u>
<u>Jen Hussey</u>	<u>Na Ali'i</u>
<u>Chrs Pyra</u>	<u>Hepure</u>
<u>Chris Lacko</u>	<u>Redox Tech</u>
<u>Mike Clark</u>	<u>Redox Tech</u>

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
<u>None</u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>
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<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>

EQUIPMENT:

Description	Description
<u>MiniRAE 3000 PID</u>	<u>(25) Barrels KMnO4</u>
<u>ChemGrout CG-680 Mixer</u>	<u>(2) Generators</u>
<u>EZ LOAD 2500 Hopper</u>	<u>(2) Eye Wash Stations</u>
<u>21,000 gal Frac Tank</u>	<u>(2) USS Porto Potties</u>
<u>6,900 gal IDW Tank</u>	<u>(2) URS Rental Vehicles</u>
<u>(2) Genie GTH-5519 Forklift</u>	<u>Yellow Jacket Drill Rig</u>
<u>Soil Hopper</u>	<u>(2) Yellow Jacket Company Trucks</u>
<u>Compressed Nitrogen Trailer</u>	<u>Yellow Jacket Equipment Truck</u>
<u>Compressed Nitrogen Tanks</u>	<u>Yellow Jacket Water Truck</u>
<u>Pressure Regulator</u>	<u>Na Ali'i Company Van</u>
<u>(4) Borehole Packers</u>	<u>Redox Tech Trailer</u>
<u>(3) MW Packers</u>	<u>Rolloff Dumpster</u>
<u>(18) 25 kg Guar Gum Bags</u>	<u></u>

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
<u>FEW4-MW61-80-PS2A-2</u>	<u>VOCs, 8260C</u>
<u></u>	<u>MEE, RSK 175</u>
<u></u>	<u>Chloride/Sulfate, 9056 A</u>
<u></u>	<u>Alkalinity, SM2320B</u>
<u>FEW4-MW61-107-PS2A-2</u>	<u>VOCs, 8260C</u>
<u></u>	<u>MEE, RSK 175</u>
<u></u>	<u>Chloride/Sulfate, 9056 A</u>
<u></u>	<u>Alkalinity, SM2320B</u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>
<u></u>	<u></u>

Brief Description of Work Performed:

Injected the following intervals with 400 lbs KMnO4 and 2420 lbs water: 100 to 105 ft bgs and 95 to 100 ft bgs. Injected the 90 to 95 ft bgs interval with 400 lbs KMnO4 and 1586 lbs water. Injected the 85 to 90 ft bgs interval with 200 lbs KMnO4 and 793 lbs water. Injected the 80 to 85 ft bgs interval with 1200 lbs KMnO4 and 4006 lbs water.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

The 4 inch drill casing in IP02 did not provide a good seal and injection slurry came up around the casing in minimal amounts during injections. Injection at the 85 to 90 ft bgs interval was stopped early and IDW was pumped into a tote. To make up for this loss and to further remediate the upper intervals, the injection amount was increased in the 80 to 85 ft bgs interval. This interval was interrupted by lighting and injected over 2 phases.

Sampled MW61-80 and MW61-107 with a bailer due to ZVI particles causing impeller issues within the Grundfos pump.

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Matthew Schmit

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	10/20/2020
Location:	Cheyenne, Wyoming	Weather:	
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company	ID Nos.	Drilled From	Drilled To:
Mike Easterday	URS			
Isaac Knutson	URS	NA		
Justin Humenik	URS			
Jennifer Hussey	Na Ali'i			
Holly Young	Na Ali'i			
Todd Marguiles	Na Ali'i			
Patrick G	Na Ali'i			

FIELD INSTALLATIONS:

EQUIPMENT:

Description	License No.	Sample ID Nos.	Analytes
(2) 300-ft Water Level Meter		FEW4-MW53-95-16	VOCs, 8260
500-ft Water Level Meter		FEW4-MW53-95-16	VOCs, 8260
(4) YSI 556		FEW4-MW73-243-16	VOCs, 8260
(8) Grundfos - Redi-Flo 2" pump		FEW4-MW73-243-MS-16	VOCs, 8260
(3) Grundfos - Redi-Flo 2" Converter Box		FEW4-MW73-243-MSD-16	VOCs, 8260
(3) LaMotte - 2020we Turbidity Meter		FEW4-MW76-87-16	VOCs, 8260
QED - MP10H Bladder Pump Controller		FEW4-MW76-87-FD-16	VOCs, 8260
(3) Generators		FEW4-MW83-271-16	VOCs, 8260
Bladder Pump w/ packer		FEW4-MW84-258-16	VOCs, 8260

ENVIRONMENTAL SAMPLES COLLECTED:

Brief Description of Work Performed:

Collected 6 groundwater samples.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Mike Easterday

PROJECT NAME: Atlas D Missile Site 4 PS
Location: Cheyenne, Wyoming
USACE PM: Jeff Gill
URS Project No.: 60613342

Date: 8/21/2020
Weather: Sunny, 90°F, 10 mph NW wind, low humidity
URS PM: Robert Mallisee
Contract/DO: W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Matthew Schmit	URS
Stephen Heinicke	URS
Gilbert Lozano	Yellow Jacket
William Blair	Yellow Jacket
Chris Hill	Yellow Jacket
Joe Mastromarchi	Na Ali'i
Chrs Pyra	Hepure
Chris Lacko	Redox Tech
Mike Clark	Redox Tech

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
None		

EQUIPMENT:

Description	Description
MiniRAE 3000 PID	(19) Barrels KMnO4
ChemGrout CG-680 Mixer	(2) Generators
EZ LOAD 2500 Hopper	(2) Eye Wash Stations
21,000 gal Frac Tank	(2) USS Porto Potties
6,900 gal IDW Tank	(2) URS Rental Vehicles
(2) Genie GTH-5519 Forklift	Yellow Jacket Drill Rig
Soil Hopper	(2) Yellow Jacket Company Trucks
Compressed Nitrogen Trailer	Yellow Jacket Equipment Truck
Compressed Nitrogen Tanks	Yellow Jacket Water Truck
Pressure Regulator	Na Ali'i Company Van
(4) Borehole Packers	Redox Tech Trailer
(3) MW Packers	Rolloff Dumpster
(18) 25 kg Guar Gum Bags	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW75-93-PS2A-2	VOCS, 8260 C
	MEE, RSK 175
	Chloride/Sulfate, 9056 A
	Alkalinity, SM2320B

Brief Description of Work Performed:

Injected the 75 to 80 ft bgs interval with 900 lbs KMnO4 and 3572 lbs water. Injected the 70 to 75 ft bgs interval with 1100 lbs KMnO4 and 6033 lbs water. KMnO4 IDW water was neutralized and transferred to the IDW holding tank. MW75-93 was purged and sampled.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

The injection amount in the 75 to 80 ft bgs and 70 to 75 ft bgs intervals was increased to as much as the intervals would accept to further remediate these intervals.

Remarks/Visitors:

NA

Signature: Matthew Schmit

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	10/22/2020
Location:	Cheyenne, Wyoming	Weather:	Clear, 35°F, 15 mph N wind
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company	ID Nos.	Drilled From	Drilled To:
Mike Easterday	URS	NA		
Isaac Knutson	URS			
Justin Humenik	URS			
Jennifer Hussey	Na Ali'i			
Holly Young	Na Ali'i			
Todd Marguiles	Na Ali'i			
Patrick G	Na Ali'i			

FIELD INSTALLATIONS:

EQUIPMENT:

Description	License No.	Sample ID Nos.	Analytes
(2) 300-ft Water Level Meter		FEW4-MW61-107-16	VOCs, 8260
500-ft Water Level Meter		FEW4-MW62-252-16	VOCs, 8260
(4) YSI 556		FEW4-MW72-205-16	VOCs, 8260
(8) Grundfos - Redi-Flo 2" pump		FEW4-MW75-93-16	VOCs, 8260
(3) Grundfos - Redi-Flo 2" Converter Box		FEW4-MW83-88-16	VOCs, 8260
(3) LaMotte - 2020we Turbidity Meter		FEW4-TB14-16	VOCs, 8260
QED - MP10H Bladder Pump Controller		FEW4-VANGOETHENNO. 1-EFF-16	VOCs, 8260
(3) Generators		FEW4-VANGOETHENNO. 1-INF-16	VOCs, 8260
Bladder Pump w/ packer		FEW4-VANGOETHENNO. 1-INT-16	VOCs, 8260
		FEW4-WELTY NO. 2-16	VOCs, 8260
		FEW4-WELTY NO. 2-FD-16	VOCs, 8260
		FEW4-MW74-104-PS1-3	VOCs, 8260

ENVIRONMENTAL SAMPLES COLLECTED:

Brief Description of Work Performed:

Collected 10 groundwater samples.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Mike Easterday

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	10/23/2020
Location:	Cheyenne, Wyoming	Weather:	Clear, 25°F, 15 mph S wind
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company	ID Nos.	Drilled From	Drilled To:
Mike Easterday	URS	NA		
Isaac Knutson	URS			
Justin Humenik	URS			
Jennifer Hussey	Na Ali'i			
Holly Young	Na Ali'i			
Todd Marguiles	Na Ali'i			
Patrick G	Na Ali'i			

FIELD INSTALLATIONS:

EQUIPMENT:

Description	License No.	Sample ID Nos.	Analytes
(2) 300-ft Water Level Meter		FEW4-BOYD-J-16	VOCs, 8260
500-ft Water Level Meter		FEW4-BOYD-NO. 3-16	VOCs, 8260
(4) YSI 556		FEW4-BOYD-NO. 3-MS-16	VOCs, 8260
(8) Grundfos - Redi-Flo 2" pump		FEW4-BOYD-NO. 3-MSD-16	VOCs, 8260
(3) Grundfos - Redi-Flo 2" Converter Box		FEW4-CANDES NO. 888-16	VOCs, 8260
(3) LaMotte - 2020we Turbidity Meter		FEW4-MW51-110-16	VOCs, 8260
QED - MP10H Bladder Pump Controller		FEW4-MW51-210-16	VOCs, 8260
(3) Generators		FEW4-MW53-177-16	VOCs, 8260
Bladder Pump w/ packer		FEW4-MW51-110-FD-16	VOCs, 8260
		FEW4-BOYD-1-16	VOCs, 8260
		FEW4-TB15-16	VOCs, 8260
		FEW4-MW96-292-16	VOCs, 8260
		FEW4-MW59-125-PS1-3	VOCs, 8260
		FEW4-MW59-74-PSI-3	VOCs, 8260

ENVIRONMENTAL SAMPLES COLLECTED:

Brief Description of Work Performed:

Collected 10 groundwater samples.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature:

Mike Easterday

PROJECT NAME:

Atlas D Missile Site 4 LTMP

Location:

Cheyenne, Wyoming

USACE PM:

Jeff Gill

URS Project No.:

60613342

Date:

9/23/2020

Weather:

Sunny 80 degrees

URS PM:

Robert Mallisee

Contract/DO:

W912DY-16-D-0026/W9128F19F0192

PERSONNEL:		FIELD INSTALLATIONS:		
Name	Company	ID Nos.	Drilled From Drilled To:	
Mike Easterday	URS			
Isaac Knutson	URS	NA		
Justin Humenik	URS			
Jennifer Hussey	Na Ali'i			
Trevor Worth	Na Ali'i			
Todd Marguelies	Na Ali'i			

EQUIPMENT:		ENVIRONMENTAL SAMPLES COLLECTED:		
Description	License No.	Sample ID Nos.	Analytes	
(2) 300-ft Water Level Meter		NA		
500-ft Water Level Meter				
(4) YSI 556				
(8) Grundfos - Redi-Flo 2" pump				
(3) Grundfos - Redi-Flo 2" Converter Box				
(3) LaMotte - 2020we Turbidity Meter				
QED - MP10H Bladder Pump Controller				
(3) Generators				

Brief Description of Work Performed:

Continued water level measurements

inspected redi-flo pumps, filled with clean DI water and decontaminated.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

Unable to record water levels at MW-84 due to drilling fluids used at MW-84B.

Water levels not recorded at MW-92 due to Colog running HPL on MW-92B adjacent to MW-92.

Will return in one week to remeasure water levels at both locations.

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature:

Mike Easterday

PROJECT NAME:

Location:

USACE PM:

URS Project No.:

Atlas D Missile Site 4 LTMP

Cheyenne, Wyoming

Jeff Gill

60613342

Date:

Weather:

URS PM:

Contract/DO:

9/24/2020

Sunny 85 degrees

Robert Mallisee

W912DY-16-D-0026/W9128F19F0192

PERSONNEL:		FIELD INSTALLATIONS:		
Name	Company	ID Nos.	Drilled From:	Drilled To:
Mike Easterday	URS			
Isaac Knutson	URS	NA		
Justin Humenik	URS			
Jennifer Hussey	Na Ali'i			
Trevor Worth	Na Ali'i			
Todd Marguelies	Na Ali'i			

EQUIPMENT:		ENVIRONMENTAL SAMPLES COLLECTED:	
Description	License No.	Sample ID Nos.	Analytes
(2) 300-ft Water Level Meter		NA	
500-ft Water Level Meter			
(4) YSI 556			
(8) Grundfos - Redi-Flo 2" pump			
(3) Grundfos - Redi-Flo 2" Converter Box			
(3) LaMotte - 2020we Turbidity Meter			
QED - MP10H Bladder Pump Controller			
(3) Generators			

Brief Description of Work Performed:

Water sampling

inspected redi-flo pumps, filled with clean DI water and decontaminated.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature:

Mike Easterday

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	6/26/2020
Location:	Cheyenne, Wyoming	Weather:	Clear, 70°F
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:		FIELD INSTALLATIONS:	
Name	Company	ID Nos.	Drilled From: Drilled To:
Jake Kokesh	URS	NA	
Jon Ortiz	URS		
Bryana Barber	URS		
Jen Hussey	Na Ali'i		
Bill Sheldon	Na Ali'i		
Joe Mastromarchi	Na Ali'i		

EQUIPMENT:		ENVIRONMENTAL SAMPLES COLLECTED:	
Description	License No.	Sample ID Nos.	Analytes
(3) 300-ft Water Level Meter		FEW4-MW83-88-15	VOCs, 8260
500-ft Water Level Meter		FEW4-MW83-88-MS-15	VOCs, 8260
(4) YSI 556		FEW4-MW83-88-MSD-15	VOCs, 8260
(7) Grundfos - Redi-Flo 2" pump		FEW4-MW74-104-15	VOCs, 8260
(3) Grundfos - Redi-Flo 2" Converter Box		FEW4-MW62-252-15	VOCs, 8260
(3) LaMotte - 2020we Turbidity Meter			
(3) Generators			
HDPE Bailer			

Brief Description of Work Performed:
Collected 3 primary samples and 1 MS/MSD

Health and Safety Levels/Activities:
Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:
NA

Changes from Workplan:
NA

Remarks/Visitors:
NA

Signature: Jake Kokesh

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	6/27/2020
Location:	Cheyenne, Wyoming	Weather:	Clear, 80°F
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:		FIELD INSTALLATIONS:	
Name	Company	ID Nos.	Drilled From: Drilled To:
Jake Kokesh	URS	NA	
Jon Ortiz	URS		
Bryana Barber	URS		
Jen Hussey	Na Ali'i		
Bill Sheldon	Na Ali'i		
Joe Mastromarchi	Na Ali'i		

EQUIPMENT:		ENVIRONMENTAL SAMPLES COLLECTED:	
Description	License No.	Sample ID Nos.	Analytes
(3) 300-ft Water Level Meter		FEW69-99-15	VOCs, 8260
500-ft Water Level Meter		FEW4-MW66-205-15	VOCs, 8260
(4) YSI 556		FEW4-MW101-106-15	VOCs, 8260
(7) Grundfos - Redi-Flo 2" pump		FEW4-MW03-15	VOCs, 8260
(3) Grundfos - Redi-Flo 2" Converter Box		FEW4-MW81-100-15	VOCs, 8260
(3) LaMotte - 2020we Turbidity Meter		FEW4-MW81-100-MS-15	VOCs, 8260
(3) Generators		FEW4-MW81-100-MSD-15	VOCs, 8260
HDPE Bailer		FEW4-MW81-207-15	VOCs, 8260
		FEW4-MW80-128-15	VOCs, 8260
		FEW4-MW61-80-15	VOCs, 8260
		FEW4-MW61-107-15	VOCs, 8260
		FEW4-MW19-15	VOCs, 8260
		FEW4-MW24-15	VOCs, 8260
		FEW4-MW64-122-15	VOCs, 8260

Brief Description of Work Performed:
Collected 12 primary samples and 1 MS/MSD

Health and Safety Levels/Activities:
Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:
NA

Changes from Workplan:
NA

Remarks/Visitors:
NA

Signature: Jake Kokesh

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	5/27/2020
Location:	Cheyenne, Wyoming	Weather:	Sunny with brief rain spurts, 77°F
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Matthew Schmit	URS
Justin Henry	URS
Joe Mastromarchi	Na Ali'i
Holly Young	Na Ali'i
Jen Hussey	Na Ali'i
Trevor Worth	Na Ali'i

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
NA		

EQUIPMENT:

Description	License No.
(2) 300-ft Water Level Meter	
500-ft Water Level Meter	
(4) YSI 556	
(5) Grundfos - Redi-Flo 2" pump	
(3) Grundfos - Redi-Flo 2" Converter Box	
(3) LaMotte - 2020we Turbidity Meter	
QED - MP10H Bladder Pump Controller	
(3) Generators	
HDPE Bailer	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW59-74-15	VOCs, 8260
FEW4-MW46-389-15	VOCs, 8260
FEW4-MW25-15	VOCs, 8260
FEW4-MW27-15	VOCs, 8260
FEW4-MW26-15	VOCs, 8260

Brief Description of Work Performed:

Collected 5 groundwater samples.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

Well pump would not work at Saber #4 stock well for Joe and Trevor, went to Airgas to try to fix but it was closed due to shortened Covid hours.

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Matthew Schmit

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	6/28/2020
Location:	Cheyenne, Wyoming	Weather:	Mostly Sunny, 85°F
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:		FIELD INSTALLATIONS:	
Name	Company	ID Nos.	Drilled From: Drilled To:
Jake Kokesh	URS	NA	
Jon Ortiz	URS		
Bryana Barber	URS		
Jen Hussey	Na Ali'i		
Bill Sheldon	Na Ali'i		
Joe Mastromarchi	Na Ali'i		

EQUIPMENT:		ENVIRONMENTAL SAMPLES COLLECTED:	
Description	License No.	Sample ID Nos.	Analytes
(3) 300-ft Water Level Meter		FEW4-MW59-125-15	VOCs, 8260
500-ft Water Level Meter		FEW4-MW28-15	VOCs, 8260
(4) YSI 556		FEW4-MW83-129-15	VOCs, 8260
(7) Grundfos - Redi-Flo 2" pump		FEW4-MW85-92-15	VOCs, 8260
(3) Grundfos - Redi-Flo 2" Converter Box		FEW4-MW66-158-15	VOCs, 8260
(3) LaMotte - 2020we Turbidity Meter		FEW4-MW101-138-15	VOCs, 8260
(3) Generators		FEW4-MW04-15	VOCs, 8260
HDPE Bailer		FEW4-MW60-90-15	VOCs, 8260
		FEW4-MW82-83-15	VOCs, 8260
		FEW4-MW60-146-15	VOCs, 8260

Brief Description of Work Performed:
Collected final 10 groundwater samples

Health and Safety Levels/Activities:
Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:
NA

Changes from Workplan:
NA

Remarks/Visitors:
NA

Signature: Jake Kokesh

PROJECT NAME:	Atlas D Missile Site 4 LTM	Date:	9/28/2020
Location:	Cheyenne, Wyoming	Weather:	clear, windy 55 degrees
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Mike Easterday	URS
Isaac Knutson	URS
Justin Humenik	URS
Jennifer Hussey	Na Ali'i
Trevor Worth	Na Ali'i
Todd Marguelies	Na Ali'i

FIELD INSTALLATIONS:

ID Nos.	Drilled From	Drilled To:
NA		

EQUIPMENT:

Description	License No.
(2) 300-ft Water Level Meter	
500-ft Water Level Meter	
(4) YSI 556	
(8) Grundfos - Redi-Flo 2" pump	
(3) Grundfos - Redi-Flo 2" Converter Box	
(3) LaMotte - 2020we Turbidity Meter	
QED - MP10H Bladder Pump Controller	
(3) Generators	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW55-250-16	VOCs, 8260
FEW4-MW59-125-16	VOCs, 8260
FEW4-MW95-165-16	VOCs, 8260
FEW4-MW95-200-16	VOCs, 8260
FEW4-MW95-288-16	VOCs, 8260
FEW4-MW95-288-FD-16	VOCs, 8260
FEW4-MW96-194-16	VOCs, 8260
FEW4-MW96-260-16	VOCs, 8260
FEW4-MW96-260-FD-16	VOCs, 8260
FEW4-MW96-260-MS/MSD-16	VOCs, 8260

Brief Description of Work Performed:

Collected 7 groundwater samples.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

NA

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Mike Easterday

PROJECT NAME:	Atlas D Missile Site 4 LTMP	Date:	5/30/2020
Location:	Cheyenne, Wyoming	Weather:	Sunny, 79°F
USACE PM:	Jeff Gill	URS PM:	Robert Mallisee
URS Project No.:	60613342	Contract/DO:	W912DY-16-D-0026/W9128F19F0192

PERSONNEL:

Name	Company
Matthew Schmit	URS
Justin Henry	URS
Joe Mastromarchi	Na Ali'i
Holly Young	Na Ali'i
Jen Hussey	Na Ali'i
Trevor Worth	Na Ali'i

FIELD INSTALLATIONS:

ID Nos.	Drilled From:	Drilled To:
NA		

EQUIPMENT:

Description	License No.
(2) 300-ft Water Level Meter	
500-ft Water Level Meter	
(4) YSI 556	
(6) Grundfos - Redi-Flo 2" pump	
(3) Grundfos - Redi-Flo 2" Converter Box	
(3) LaMotte - 2020we Turbidity Meter	
QED - MP10H Bladder Pump Controller	
(3) Generators	
HDPE Bailer	

ENVIRONMENTAL SAMPLES COLLECTED:

Sample ID Nos.	Analytes
FEW4-MW59-183-15	VOCs, 8260
FEW4-MW59-183-MS-15	VOCs, 8260
FEW4-MW59-183-MSD-15	VOCs, 8260
FEW4-MW75-93-15	VOCs, 8260
FEW4-MW75-308-15	VOCs, 8260
FEW4-MW44R-242-15	VOCs, 8260
FEW4-MW44R-308-15	VOCs, 8260
FEW4-MW44R-207-15	VOCs, 8260
FEW4-MW97-266-15	VOCs, 8260
FEW4-MW50-318-15	VOCs, 8260

Brief Description of Work Performed:

Collected 8 groundwater samples.

Health and Safety Levels/Activities:

Level D, Daily Safety Tailgate Meeting

Problems Encountered and Corrective Action taken:

Controller maxed out at 400 Hz at MW74-359 and stopped pumping water. Shut pump off and let well recharge.

Pump heated up to between 14 and 15 °C at MW45R-deep and MW44R-331. Shut off pump to cool off and allow water to recharge.

Changes from Workplan:

NA

Remarks/Visitors:

NA

Signature: Matthew Schmit