LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

ADMINISTRATIVE RECORD

Volume 1

2019

Bate Stamp Numbers
00915175 – 00916344

Prepared for

Department of the Army
Longhorn Army Ammunition Plant

1976 – 2019

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD – CHRONOLOGICAL INDEX

VOLUME 1

2019

A. Title: Report – Limited Groundwater Monitoring for Perchlorate at LHAAP-001-R-01 (South Test Area/Bomb Test Area), Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: January 25, 2019
Date Stamp: 00915175 – 00915648

B. Title: Transmittal Letter – Draft Explanation of Significant Differences, Record of Decision Dated September 2010, Contingency Remedy at LHAAP-50, Former Sump Water Tank, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: February 7, 2019
Bate Stamp: 00915649 – 00915649

C. Title: Transmittal Letter – Draft Explanation of Significant Differences, Record of Decision Dated September 2010, Contingency Remedy at LHAAP-50, Former Sump Water Tank, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Texas Commission on Environmental Quality
Date: February 7, 2019
Date Stamp: 00915650 – 00915650

D. Title: Minutes – Final Minutes, Monthly Managers' Meeting (MMM), Longhorn Army Ammunition Plant, Karnack, Texas, December 12, 2018
Author(s): Department of the Army
Recipient: All Parties
Date: February 15, 2019
Bate Stamp: 00915651 – 00915659

E. Title: Transmittal Letter – Draft Remedial Design/Remedial Action Work Plan, LHAAP-04 Former Pilot Wastewater Treatment Plant, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: February 20, 2019
Bate Stamp: 00915660 – 00915660

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F. Title: Transmittal Letter – Draft Remedial Design/Remedial Action Work Plan, LHAAP-04 Former Pilot Wastewater Treatment Plant, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Texas Commission on Environmental Quality
Date: February 20, 2019
Bate Stamp: 00915661 – 00915661

G. Title: Report – Final Technical Memorandum – Monitored Natural Attenuation Monitoring Parameters, Longhorn Army Ammunition Plant, Karnack, Texas, February 2019
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: February 26, 2019
Bate Stamp: 00915662 – 00915679

H. Title: Report – Final Proposed Plan for LHAAP-18/24 Burning Ground No. 3 and Unlined Evaporation Pond, Longhorn Army Ammunition Plant, Karnack, Texas, February 2019
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: February 26, 2019
Bate Stamp: 00915680 – 00915710

I. Title: Report – Longhorn Amy Ammunition Plant, Army Cleanup Program, FY18 Final Installation Action Plan, February 26, 2019, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Environmental Protection Agency and Texas Commission on Environmental Quality
Date: February 26, 2019
Bate Stamp: 00915711 – 00915772

J. Title: Minutes – Final Minutes, Monthly Managers' Meeting (MMM), February 14, 2019, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: All Parties
Date: February 27, 2019
Bate Stamp: 00915773 – 00915814

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K. Title: Transmittal Letter – Draft Proposed Plan for LHAAP-18/24, Burning Ground No. 3 and Unlined Evaporation Pond, October 2018, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: October 22, 2018
Bate Stamp: 00915815 – 00915815

L. Title: Transmittal Letter – Draft Proposed Plan for LHAAP-18/24, Burning Ground No. 3 and Unlined Evaporation Pond, October 2018, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Texas Commission on Environmental Quality
Date: October 22, 2018
Bate Stamp: 00915816 – 00915816

M. Title: Report – Fact Sheet, LHAAP-18/24 Proposed Plan, Burning Ground No. 3 and Unlined Evaporation Pond, Longhorn Army Ammunition Plant, Karnack, Texas
Author(s): Department of the Army
Recipient: Public
Date: March 5, 2019
Bate Stamp: 00915817 – 00915820

N. Title: Report – Draft Final Remedial Design and Remedial Action Work Plan, LHAAP-17, Burning Ground No. 2 / Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas, March 2019
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: March 7, 2018
Bate Stamp: 00915821 – 00915990

O. Title: Report – Draft Final Post Screening Investigation Report, LHAAP-47, Longhorn Army Ammunition Plant, Karnack, Texas, March 2019
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: March 18, 2019
Bate Stamp: 00915991 – 00916344

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

January 25, 2019

DAIM-ODB-LO

Mr. Rich Mayer
U.S. Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Limited Groundwater Monitoring for Perchlorate at LHAAP-001-R-01 (South Test Area/Bomb Test Area), Longhorn Army Ammunition Plant, Karnack, Texas, January 2019

Dear Mr. Mayer,

One hard copy and one compact disc (CD) of the above-referenced document is being transmitted to you for your review. A schedule for document review will be coordinated with you at the conclusion of the partial government shutdown.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) team, on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX (1 hard copy and 1 CD)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy and 1 CD)
A. Williams, USACE, Tulsa District, OK (1 CD)
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate, Lakewood, CO (1 hard copy and 1 CD)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

January 25, 2019

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality
Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Limited Groundwater Monitoring for Perchlorate at LHAAP-001-R-01 (South Test Area/Bomb Test Area), Longhorn Army Ammunition Plant, Karnack, Texas, January 2019

Dear Ms. Palmie,

One hard copy and one compact disc (CD) of the above-referenced document are being transmitted to you for your review. In accordance with the Federal Facilities Agreement for Longhorn, review comments are requested by February 26, 2019. However, since EPA is not available for consultation, your comments will be accepted within the schedule coordinated with EPA upon the conclusion of the shutdown.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) team, on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX (1 hard copy and 1 CD)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy and 1 CD)
A. Williams, USACE, Tulsa District, OK (1 CD)
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate, Lakewood, CO (1 hard copy and 1 CD))

MEMORANDUM FOR THE RECORD

Date: **January 25, 2019**

SUBJECT: **Limited Groundwater Monitoring for Perchlorate at LHAAP-001-R-01 (South Test Area/Bomb Test Area), Longhorn Army Ammunition Plant, Karnack, Texas**

This memorandum presents the methodology and analytical results for the limited monitoring for perchlorate in groundwater at LHAAP-001-R-01 (South Test Area/Bomb Test Area). Three annual sampling events were conducted on September 28, 2016; November 20 and 21, 2017; and November 6 and 7, 2018. The purpose of the groundwater sampling and analysis is to confirm that the levels of perchlorate in groundwater are below the Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL), which is the State remedial standard utilized in the absence of a federal drinking water standard. The PCL for perchlorate is 17 micrograms per liter (µg/L). The six groundwater monitoring wells sampled at LHAAP-001-R-01 (27WW01, 27WW02, 27WW03, 27WW04, MW-131, and MW-132) are screened in the shallow zone. **Figure 1** presents the groundwater monitoring well locations at Site LHAAP-001-R-01. The sampling rationale and methodology followed the procedures documented in the Installation-Wide Work Plan (IWWP; Bhate Environmental Associates, Inc. [Bhate], May 2018). Sampling for perchlorate was conducted based on the requirements of the Final Record of Decision (ROD) for LHAAP-001-R-01 (South Test Area/Bomb Test Area) and LHAAP-003-R-01 (Ground Signal Test Area; Shaw Environmental & Infrastructure, Inc. [Shaw], August 2016).

Site Description and History

Site LHAAP-001-R-01 (South Test Area/Bomb Test Area), is located in the southern portion of Longhorn Army Ammunition Plant (LHAAP) and covers an area of approximately 79 acres. Site LHAAP-001-R-01 was constructed in 1954 and used for testing photoflash bombs produced at the facility until approximately 1956. During the late 1950s, illuminating signal devices were also demilitarized within pits excavated in the vicinity of the test pad. During the 1960s, leaking production items may have been demilitarized by detonation.

Between May 2000 and February 2001, during three consecutive quarterly sampling events at LHAAP-001-R-01, groundwater samples were collected from six existing shallow monitoring wells to determine whether perchlorate was present in the underlying groundwater as a result of past historical activities. The monitoring wells are located in areas with the highest potential for impact from site activities and in the direction of groundwater flow across the site from west to east, toward Harrison Bayou. During the first quarter (April to May 2000), groundwater samples were collected from four of the six monitoring wells (MW-131, MW-132, 27WW01, and 27WW04). Perchlorate was detected in two of the wells, 27WW01 and 27WW04, at concentrations of 52.6 and 16.4 µg/L, respectively (Solutions to Environmental Problems [STEP],

June 2005). The concentration detected in 27WW01 was above the TRRP Tier 1 Groundwater Residential PCL of 17 µg/L. No Maximum Contaminant Level (MCL) exists for perchlorate. Perchlorate concentrations were below detection limits in all of the six monitoring wells (MW-131, MW-132, and 27WW01 through 27WW04) sampled during the second quarter (August through October 2000). During the third quarter, January through February 2001, perchlorate was not detected in the groundwater samples collected from three sampled wells, MW-131, 27WW01, and 27WW04. This quarterly groundwater sampling is documented in the Final Munitions Constituents Data Summary Report (Shaw, June 2011).

In October 2009, the U.S. Environmental Protection Agency (USEPA) collected additional groundwater samples from the six monitoring wells to confirm groundwater conditions at the site. Perchlorate was detected in three wells, MW-132, 27WW02, and 27WW03 at concentrations of 2.6, 3.2, and 76 µg/L, respectively. The USEPA's perchlorate detection of 76 µg/L was an estimate from a diluted sample. The U.S. Army collected split samples at the same time that the USEPA collected samples from the six monitoring wells. Perchlorate was detected in two of the wells, 27WW02 and 27WW03, at concentrations of 3.4 and 50 µg/L, respectively. Only monitoring well 27WW03 had groundwater with perchlorate detected above the TRRP Tier 1 Groundwater Residential PCL of 17 µg/L (Shaw, June 2011).

2016 Perchlorate Groundwater Sampling Event Number 1

On September 23, 2016, prior to collecting the groundwater samples, monitoring wells 27WW01, 27WW02, 27WW03, 27WW04, 131, and 132 were re-developed (development forms are provided in **Appendix A**). On September 28, 2016, AECOM Technical Services, Inc. (AECOM) conducted the first perchlorate groundwater sampling event per the Final ROD (Shaw, August 2016). Groundwater samples were collected from shallow zone monitoring wells (27WW01, 27WW02, 27WW03, 27WW04, MW-131, and MW-132), and analyzed for perchlorate using USEPA Method SW 6850. Prior to sampling, the depth to groundwater and total depth of each monitoring well were measured using a Solinst Model 101 water level meter. Groundwater samples were collected using low-flow sampling techniques in accordance with the IWWP (AECOM, July 2014). A bladder pump was lowered into the well and placed within the screened interval, then pumped at a rate of approximately 100 milliliters per minute (mL/min). The groundwater was pumped through a flow-through cell where field parameters including temperature, pH, conductivity, oxygen reduction potential (ORP), dissolved oxygen (DO), and turbidity were measured using a U-52 Horiba water quality meter. After the groundwater parameters stabilized within the ranges specified in the IWWP (AECOM, July 2014), each groundwater sample was collected in a 250-milliliter (mL) clear plastic bottle. The bottles were labelled and placed in coolers containing ice for temporary storage and shipment to the Microbac Laboratories located in Marietta, Ohio following chain of custody procedures. Groundwater Field Sampling Forms for the September 2016 sampling event are provided in **Appendix B.**

A field duplicate quality control (QC) sample was also collected as prescribed in the IWWP (AECOM, July 2014) to assess the precision, accuracy, and representativeness of the analytical results. The groundwater samples were analyzed within the maximum holding time for Method

SW 6850. Analytical data received from Microbac Laboratory were validated in accordance with the quality assurance (QA)/QC requirements for this project and were determined to be usable for their intended purpose. The data validation information is summarized in the Quality Control Summary Report (QCSR) presented in **Appendix C**. The laboratory report for the September 2016 groundwater sampling event is provided in **Appendix D**.

Based on review of the laboratory analytical results, perchlorate was not detected in any of the groundwater monitoring wells, with the exception of 27WW02. Perchlorate was detected at 0.705 µg/L in 27WW02, which is well below the TRRP Tier 1 Groundwater Residential PCL of 17 µg/L. The September 2016 groundwater analytical results for perchlorate are presented in **Table 1**.

2017 Perchlorate Groundwater Sampling Event Number 2

On November 20 and 21, 2017, Bhate conducted the second perchlorate groundwater sampling event per the Final ROD (Shaw, August 2016). Groundwater samples were collected from shallow zone monitoring wells (27WW01, 27WW02, 27WW03, 27WW04, MW-131, and MW-132), and analyzed for perchlorate using USEPA Method SW 6850. A field duplicate QC sample was also collected as prescribed in the IWWP (AECOM, July 2014) to assess the precision, accuracy, and representativeness of the analytical results. Prior to sampling, the depth to groundwater and total depth of each monitoring well were measured using a Solinst Model 101 water level meter to calculate water column height. Groundwater samples were collected using low-flow sampling techniques (SamplePro Bladder Pump), at a pumping rate of approximately 100 mL/min. The bladder pump was lowered into each well and placed within the screened interval. Groundwater was pumped through 1/4-inch tubing to the ground surface and then through a flow-through cell where field parameters, including temperature, pH, conductivity, ORP, DO, and turbidity were measured using a Horiba U-52 water quality meter. After the groundwater parameters stabilized within the ranges specified in the IWWP (AECOM, July 2014), each groundwater sample was collected in a 250-mL clear plastic bottle. The bottles were labeled and placed in a cooler containing ice for temporary storage and shipment to ALS Environmental Laboratory (ALS) located in Salt Lake City, Utah following chain of custody procedures. Groundwater Field Sampling Forms for the November 2017 sampling event are provided in **Appendix B.**

The groundwater samples were analyzed within the maximum holding time for Method SW 6850. Analytical data received from ALS were validated in accordance with the QA/QC requirements for this project and were determined to be usable for their intended purpose. The data validation information is summarized in the QCSR presented in **Appendix C**. The laboratory report for the November 2017 groundwater sampling event is provided in **Appendix D**.

In November 2017, perchlorate was not detected in any of the six groundwater monitoring wells sampled, including the field duplicate sample. The November 2017 groundwater analytical results for perchlorate are presented in **Table 2**.

2018 Perchlorate Groundwater Sampling Event Number 3

On November 6 and 7, 2018, Bhate conducted the third perchlorate groundwater sampling event per the Final ROD (Shaw, August 2016). Groundwater samples were collected from shallow zone monitoring wells (27WW01, 27WW02, 27WW03, 27WW04, MW-131, and MW-132), and analyzed for perchlorate using USEPA Method SW 6850. Prior to sampling, the depth to groundwater and total depth of each monitoring well were measured using a Solinst Model 101 water level meter to calculate water column height. Groundwater samples were collected using low-flow sampling techniques (SamplePro Bladder Pump), at a pumping rate of approximately 100 mL/min. The bladder pump was lowered into each well and placed within the screened interval. Groundwater was pumped through 1/4-inch tubing to the ground surface and then through a flow-through cell where field parameters, including temperature, pH, conductivity, ORP, DO, and turbidity were measured using a Horiba U-52 water quality meter. After the groundwater parameters stabilized within the ranges specified in the IWWP (Bhate, May 2018), each groundwater sample was collected in a 250-mL clear plastic bottle. The bottles were labeled and placed in a cooler containing ice for temporary storage and shipment to ALS located in Houston, TX. Analysis for perchlorate was subcontracted to the Salt Lake City laboratory location, following chain of custody procedures. Groundwater Field Sampling Forms for the November 2018 sampling event are provided in **Appendix B**.

A field duplicate QC sample was collected as prescribed in the IWWP (Bhate, May 2018) to assess the precision, accuracy, and representativeness of the analytical results. The groundwater samples were analyzed within the maximum holding time for Method SW 6850. Analytical data received from ALS Environmental Laboratory were validated in accordance with the QA/QC requirements for this project and were determined to be usable for their intended purpose. The data validation information is summarized in the QCSR presented in **Appendix C**. The laboratory report for the November 2018 groundwater sampling event is provided in **Appendix D**.

With the exception of monitoring well 27WW02, perchlorate was not detected. The detected perchlorate in monitoring well 27WW02 was estimated at 2.5 µg/L of perchlorate, which is less than the TRRP PCL of 17 µg/L. The November 2018 groundwater analytical results for perchlorate are presented in **Table 3**.

Conclusions

The three annual sampling events (September 2016, November 2017, and November 2018) perchlorate analytical results from the shallow groundwater at LHAAP-001-R indicate that perchlorate is at levels below the PCL. Per the ROD, if after three rounds of groundwater sampling at LHAAP-001-R-01, the results that are evaluated on or before the first five-year review indicate detections at levels below the TRRP Tier 1 Groundwater Residential PCL value of 17 µg/L for perchlorate, groundwater monitoring will cease and the wells will be plugged and abandoned. Therefore, groundwater monitoring at LHAAP-001-R-01 should cease and the monitoring wells will be plugged and abandoned.

References

AECOM. July 2014. *Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant, Karnack, Texas*.

Bhate. May 2018. *Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant, Karnack, Texas*.

Shaw. June 2011. *Final Munitions Constituents Data Summary Report South Test Area/Bomb Test Area LHAAP-001-R and Ground Signal Test Area, LHAAP-003-R, Longhorn Army Ammunition Plant, Karnack, Texas.*

Shaw. August 2016. *Final Record of Decision LHAAP-001-R (South Test Area/Bomb Test Area and LHAAP-003-R (Ground Signal Test Area) Longhorn Army Ammunition Plant, Karnack, Texas*.

STEP. June 2005. *Plant-wide Perchlorate Investigation, Longhorn Army Ammunition Plant, Karnack, Texas*.

FIGURE

00915183

0 125 250 500 Feet

AVE "L"

70TH ST.

DST-3

BST-4

BST-2

27WW04

27WW02

27WW01

27WW03

131

132

MMRP Site
LHAAP-001-R
(South Test Area/Bomb Test Area)

190

210

200

180

Notes:
This information is depicted to provide visual aid within the context of this document and should not be used as a sole reference in precise dimensioning of features indicated. Please verify the location of all features including underground and aboveground utilities prior to conducting any subsurface exploration or site assessment.

Legend:

- Shallow Monitoring Well Location
- Installation Restoration Program (IRP) Area
- Stream
- 190 Ground Elevation Contour in Feet Above Mean Sea Level
- Fence Line
- United States Fish and Wildlife Service (USFWS) / Refuge Area
- MMRP Military Munitions Response Program
- *BST-2* Building Number

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

LHAAP-001-R-01
South Test Area / Bomb Test Area
Sampling Locations

Figure 1

2018 Groundwater Monitoring Technical Memo
LHAAP-001-R-01 Longhorn Army Ammunition Plant
Karnack, Texas

DRAWN BY: MRM

DATE: 12/6/2018

SCALE: As Shown

PROJECT NO: NWO1312.0150.014.0001.04

bhate

TABLES

Table 1: LHAAP-001-R-01 September 2016 Perchlorate Results

Location ID: Sample Date:	Units	TRRP PCL	27WW02-092816 9/28/16	27WW04-092816 9/28/16	131-092816 9/28/16	132-092816 9/28/16	132FD-092816 9/28/16	27WW03-092816 9/28/16	27WW01-092816 9/28/16
Well location:			NW, inside site boundary	NW, inside site boundary	N, inside OB/OD area	S, inside OB/OD area	S, inside OB/OD area. Field Duplicate	W, inside OB/OD area	NW, inside site boundary
Perchlorate (6850)									
Perchlorate	µg/L	17	0.705	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U	< 0.2 U

Notes:

µg/L - micrograms per liter

TRRP PCL - Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Level

U- Undetected: The analyte was analyzed for, but not detected

Table 2: LHAAP-001-R-01 November 2017 Perchlorate Results

Location ID: Sample Date:	Units	TRRP PCL	27WW02-112017 11/20/17	27WW04-112017 11/20/17	131-112117 11/21/17	132-112117 11/21/17	27WW03-112117 11/21/17	27WW01-112117 11/21/17	27WW01-112117-a 11/21/17
Well location:			NW, inside site boundary	NW, inside site boundary	N, inside OB/OD area	S, inside OB/OD area	W, inside OB/OD area	NW, inside site boundary	NW, inside site boundary. Field duplicate.
Perchlorate (6850)									
Perchlorate	µg/L	17	< 4.0 U	< 4.0 U	< 4.0 U	< 4.0 U	< 4.0 U	< 4.0 U	< 4.0 U

Notes:

µg/L - micrograms per liter

TRRP PCL - Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Level

U- Undetected: The analyte was analyzed for, but not detected

Table 3: LHAAP-001-R-01 November 2018 Perchlorate Results

Location ID: Sample Date:	Units	TRRP PCL	27WW01_110718 11/7/18	27WW02_110718 11/7/18	27WW03_110618 11/6/18	27WW04_110618 11/6/18	27WW04_110618a 11/6/18	131_110618 11/6/18	132_110618 11/6/18
Well Location:			NW, inside site boundary.	NW, inside site boundary.	W, inside OB/OD area.	NW, inside site boundary.	NW, inside site boundary. Field duplicate.	N, inside OB/OD area.	S, inside OB/OD area.
Perchlorate (6850)									
Perchlorate	µg/L	17	< 2.0 UJ	**2.5 J**	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U

Notes:

µg/L - micrograms per liter

TRRP PCL - Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Limit

U- Undetected: The analyte was analyzed for, but not detected and reported to the limit of detection

J - estimated result between the detection limit and limit of quantitation

UJ - Estimated non-detect due to discrepancies in meeting certain analyte-specific quality control criteria

APPENDIX A
MONITORING WELL DEVELOPMENT FORMS – SEPTEMBER 2016

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 001 (27)		LocID: 27WW01	Date: 9/23/16	
	Project Name: Longhorn Army Ammunition Plant		Project #: 60256135	Recorded By: Beesinger	Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: U-52 HORIBA 21168			Water Level Indicator Type/ID #: Solinst 101	
	Equipment Group: NA			Equpment Group: NA	
	Development Equipment: Bailer, Surge block			Equipment Decon.: Liquinox & DI WATER	
WELL INFO	Casing I.D. (in) [a]: 4"		Unit Casing Volume (gal/lin ft) [b]: 0.65	Initial Depth to Water (ft) [c]: 15.15	
	Total Well Depth (ft) [d]: 30.21		Water Column Thickness (ft) [d-c]: 15.06	Well Volume (gal) {[d-c] x b}: 9.78	
	Ground Condition of Well:			Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	**2.0**	2.2	3.0	**4.0**	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	**0.16**	0.20	0.37	**0.65**	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Radiation ( )	Remarks (odor, clarity, etc.)
9/23/16	0817	Bail	21.65	10	NA	21.42	4.90	4.52	9.93	808	240		
9/23/16	0825	Bail	24.36	10	NA	20.68	5.15	4.67	9.87	117	179		
9/23/16	0840	Bail	28.33	10	NA	20.59	5.19	4.78	9.80	~~384~~ 381	164		
				Bailed			3 well volumes						

Development Criteria: **1)** sediment <0.75 mL/L, **2)** turbidity within 10 NTU range for 30 minutes, **3)** +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 001 (27)		LocID: 27WW02	Date: 9/23/16	
	Project Name: Longhorn Army Ammunition Plant		Project #: 60256135	Recorded By: Beesinger	Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: U-52 HORIBA 21168			Water Level Indicator Type/ID #: Solinst 101	
	Equipment Group: NA			Equpment Group: NA	
	Development Equipment: Bailer, Surge block			Equipment Decon.: Liquinox & DI WATER	
WELL INFO	Casing I.D. (in) [a]: 4"		Unit Casing Volume (gal/lin ft) [b]: 0.65	Initial Depth to Water (ft) [c]: 8.60	
	Total Well Depth (ft) [d]: 20.45		Water Column Thickness (ft) [d-c]: 11.85	Well Volume (gal) {[d-c] x b}: 7.70	
	Ground Condition of Well:			Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	**2.0**	2.2	3.0	**4.0**	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	**0.16**	0.20	0.37	**0.65**	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Radiation ( )	Remarks (odor, clarity, etc.)
9/23/16	0900	Bail	11.00	8	NA	21.73	5.24	7.22	9.10	169	158		
9/23/16	0910	Bail	12.06	8	NA	21.46	5.64	7.88	8.99	63.1	116		
9/23/16	0920	Bail	13.76	8	NA	21.24	5.67	7.92	8.86	22.3	107		

Bailed 3 well volumes

Development Criteria: **1)** sediment <0.75 mL/L, **2)** turbidity within 10 NTU range for 30 minutes, **3)** +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

00915191

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 001 (27)		LocID: 27WW04	Date: 9/23/16	
	Project Name: Longhorn Army Ammunition Plant		Project #: 60256135	Recorded By: Beesinger	Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: U-52 HoriBA 21168			Water Level Indicator Type/ID #: Solinst 101	
	Equipment Group: NA			Equpment Group: NA	
	Development Equipment: Bailer, Surge block			Equipment Decon.: LiQuinox & DI WATER	
WELL INFO	Casing I.D. (in) [a]: 4"		Unit Casing Volume (gal/lin ft) [b]: 0.65	Initial Depth to Water (ft) [c]: 7.80	
	Total Well Depth (ft) [d]: 20.44		Water Column Thickness (ft) [d-c]: 12.64	Well Volume (gal) {[d-c] x b}: 8.21	
	Ground Condition of Well:			Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	**2.0**	2.2	3.0	**4.0**	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	**0.16**	0.20	0.37	**0.65**	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Radiation ( )	Remarks (odor, clarity, etc.)
9/23/16	0945	Bail	13.31	8	~~NA~~	22.32	6.06	8.47	9.24	68.6	79		
9/23/16	0954	Bail	16.90	8	NA	21.24	6.00	8.51	8.53	44.2	87		
9/23/16	1015	Bail	15.80	8	NA	21.33	5.85	8.47	8.58	20.3	95		

Bailed 3 well volumes

Development Criteria: **1)** sediment <0.75 mL/L, **2)** turbidity within 10 NTU range for 30 minutes, **3)** +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

00915192

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 001 (27)		LocID: 27WW03		Date: 9/23/16
	Project Name: Longhorn Army Ammunition Plant		Project #: 60256135		Recorded By: Beesinger Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: U-52 HORIBA 2116837			Water Level Indicator Type/ID #: Solinst 100	
	Equipment Group: NA			Equpment Group: NA	
	Development Equipment: Bailer, Surge block			Equipment Decon.: LIQUINOX & DI WATER	
WELL INFO	Casing I.D. (in) [a]: 4"		Unit Casing Volume (gal/lin ft) [b]: 0.65		Initial Depth to Water (ft) [c]: 9.71
	Total Well Depth (ft) [d]: 20.45		Water Column Thickness (ft) [d-c]: 10.74		Well Volume (gal) {[d-c] x b}: 6.98
	Ground Condition of Well:			Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	**2.0**	2.2	3.0	**4.0**	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	**0.16**	0.20	0.37	**0.65**	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Radiation ( )	Remarks (odor, clarity, etc.)
9/23/16	1230	Bail	13.25	7	NA	24.10	5.25	3.51	8.29	25.5	155		
9/23/16	1235	Bail	15.33	7	NA	22.65	5.22	3.65	8.76	19.7	185		
9/23/16	1245	Bail	17.06	7	NA	22.28	5.17	3.71	8.46	15.3	194		
		Bailed			3	well		Volumes					

Development Criteria: **1)** sediment <0.75 mL/L, **2)** turbidity within 10 NTU range for 30 minutes, **3)** +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

00915193

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 001 (27)	LocID: 132	Date: 9/23/16
	Project Name: Longhorn Army Ammunition Plant	Project #: 60256135	Recorded By: Beasinger Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: U-52 HORIBA 21168		Water Level Indicator Type/ID #: Solinst 101
	Equipment Group: NA		Equpment Group: NA
	Development Equipment: Bailer		Equipment Decon.: LIQUINOX & DI WATER
WELL INFO	Casing I.D. (in) [a]: 2"	Unit Casing Volume (gal/lin ft) [b]: 0.16	Initial Depth to Water (ft) [c]: 9.79
	Total Well Depth (ft) [d]: 27.46	Water Column Thickness (ft) [d-c]: 17.67	Well Volume (gal) {[d-c] x b}: 2.82
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	**2.0**	2.2	3.0	**4.0**	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	**0.16**	0.20	0.37	**0.65**	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Radiation ( )	Remarks (odor, clarity, etc.)
9/23/16	1306	BAIL	12.60	3	NA	23.60	5.85	7.59	9.30	239	132		
9/23/16	1315	BAIL	14.89	3	NA	23.43	6.61	7.79	8.23	42.1	60		
9/23/16	1322	BAIL	15.73	3	NA	23.35	6.72	7.78	8.00	21.2	51		
			BAILED 3 well volumes										

Development Criteria: **1)** sediment <0.75 mL/L, **2)** turbidity within 10 NTU range for 30 minutes, **3)** +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 001 (27)	LocID: 131		Date: 9/23/16	
	Project Name: Longhorn Army Ammunition Plant	Project #: 60256135		Recorded By: Beesinger	Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: U-52 Horiba 21168		Water Level Indicator Type/ID #: Solinst 101		
	Equipment Group: NA		Equpment Group: NA		
	Development Equipment: Bailer		Equipment Decon.: Liquinox & DI WATER		
WELL INFO	Casing I.D. (in) [a]: 2"	Unit Casing Volume (gal/lin ft) [b]: 0.16	Initial Depth to Water (ft) [c]: 11.03		
	Total Well Depth (ft) [d]: 18.48	Water Column Thickness (ft) [d-c]: 7.45	Well Volume (gal) {[d-c] x b}: 1.19		
	Ground Condition of Well:		Remarks:		

CASING INFO											
Casing I.D. (in) [a]:	1.5	**2.0**	2.2	3.0	**4.0**	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	**0.16**	0.20	0.37	**0.65**	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Radiation ( )	Remarks (odor, clarity, etc.)
9/23/16	1340	Bail	13.24	1.25	NA	23.82	6.30	4.10	7.72	80.8	0		
9/23/16	1343	Bail	13.85	1.25	NA	23.66	6.43	4.03	8.24	33.2	-17		
9/23/16	1347	Bail	14.20	1.25	NA	23.29	6.25	4.07	8.19	20.0	-21		
			Bailed	3	well	volumes							

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

APPENDIX B
GROUNDWATER FIELD SAMPLING FORMS

SEPTEMBER 2016 GROUNDWATER FIELD SAMPLING FORMS

AECOM

MONITORING WELL SAMPLE COLLECTION FORM

LOCATION	Site: 003 (Site 54)	LocID: 127	Date: 9/29/16
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0006EA 001 - 003 LUC5 FL	Recorded By: Scott Beesinger Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator: Solinst ID#: 101	Min Recharge Level = (TD-DTW(0.80)) - TD
	Unit # 21168	Sampling Equipment: Bladder Pump ID#:	
WELL INFO	Casing I.D. (in): 2"	Static Water Level Reading (ft) from TOC: 16.67	Weather Conditions: CLEAR
	Total Well Depth (ft) from TOC: 28.22	Screen Intverval (ft) from TOC: 13.20 - 28.20	Condition of Well/Remarks: needs paint
		Pump Placement (ft) from TOC: 20.70	

CASING INFO												
Casing I.D. (in):	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft):	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (µS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
9/29/16	0915	16.63	100	18.89	5.70	1.44	2.50	135	58	
	0920	16.70	100	18.87	5.54	1.38	1.79	112	66	
	0925	16.75	100	18.84	5.49	1.38	1.61	91.2	67	
	0930	16.80	100	18.83	5.46	1.39	1.35	72.2	70	
	0935	16.82	100	18.82	5.48	1.39	1.22	49.3	70	
	0940	16.83	100	18.81	5.46	1.40	1.23	48.7	69	
	0945	16.83	100	18.80	5.47	1.40	1.25	48.5	68	
	0950	16.83	100	18.79	5.45	1.41	1.23	48.3	68	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU Ideal), for 4 consecutive readings

SAMPLE ID: 127-092916 TIME: 0950

DUPLICATE (D): YES/NO NO
MATRIX SPIKE (MS): YES/NO YES
MATRIX DUPLICATE (MD): YES/NO YES

CO= LEL= OXY= H2S=

No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
3 - 250 ml plastic	NA	Y	Pump	perchlorate

00915198

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AECOM

MONITORING WELL SAMPLE COLLECTION FORM

LOCATION	Site: 003 (Site 54)	LocID: 128	Date: 9/29/16
	Project: Longhorn Army Ammunition Plant	Project No. 60256135.0006EA 001 - 003 LUC5 FL	Recorded By: Scott Beesinger Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52	Water Interface Probe: Water Level Indicator: Solinst ID#: 101	Min Recharge Level = (TD-DTW(0.80)) - TD
	Unit # 21168	Sampling Equipment: Bladder Pump ID#:	
WELL INFO	Casing I.D. (in): 2"	Static Water Level Reading (ft) from TOC: 27.01	Weather Conditions: CLEAR
	Total Well Depth (ft) from TOC: 35.09	Screen Intverval (ft) from TOC: 20.00 - 35.00	Condition of Well/Remarks: Needs paint
		Pump Placement (ft) from TOC: ~~25.00~~ 30.00	

CASING INFO												
Casing I.D. (in):	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft):	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (µS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
9/29/16	0805	26.98	100	18.96	6.08	4.21	3.54	5.5	124	
	0810	27.05	100	18.63	5.86	4.20	2.51	36.1	140	
	0815	27.11	100	18.46	5.81	4.21	2.12	47.1	146	
	0820	27.15	100	18.39	5.80	4.29	1.73	31.1	146	
	0825	27.18	100	18.31	5.79	4.30	1.70	31.5	144	
	0830	27.20	100	18.28	5.81	4.31	1.68	31.0	142	
	0835	27.22	100	18.25	5.82	4.31	1.67	30.6	140	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU ideal), for 4 consecutive readings

SAMPLE ID: 128-092916 TIME: 0835

DUPLICATE (D): YES/NO Yes

MATRIX SPIKE (MS): YES/NO NO

MATRIX DUPLICATE (MD): YES/NO NO

CO= LEL= OXY= H2S=

No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
2 - 250 ml plastic	NA	Y	Pump	perchlorate

00915199
Page 1 of ___

AECOM

MONITORING WELL SAMPLE COLLECTION FORM

LOCATION	Site: 003 (Site 54)		LocID: 18WW16	Date: 9/28/16	
	Project: Longhorn Army Ammunition Plant		Project No. 60256135.0006EA 001 - 003 LUC5 FL	Recorded By: Scott Beesinger	Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: Horiba U-52		Water Interface Probe: Water Level Indicator: Solinst ID#: 101	Min Recharge Level = (TD-DTW(0.80)) - TD	
	Unit # 211168		Sampling Equipment: ~~Bladder Pump~~ Bailer ID#:		
WELL INFO	Casing I.D. (in): 4"		Static Water Level Reading (ft) from TOC: 31.64	Weather Conditions: CLEAR	
	Total Well Depth (ft) from TOC: 33.71		Screen Intverval (ft) from TOC: 23.75 - 33.75	Condition of Well/Remarks: needs paint	
			Pump Placement (ft) from TOC:		

CASING INFO												
Casing I.D. (in):	0.75	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft):	0.023	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Pumping Rate (mL/min)	Temp. (°C)	pH	Cond (µS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)
9/28/16	1448	31.64	NA							Bailing well
9/28/16	1455	33.62	NA							Bailed 1 gallon RAN DRY
9/29/16	0740	31.69	NA	19.93	3.68	5.75	NA	47.1	NA	

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-10% C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU ideal), for 4 consecutive readings

SAMPLE ID: 18NW16-092916 TIME: 0740

DUPLICATE (D): YES/NO NO
MATRIX SPIKE (MS): YES/NO NO
MATRIX DUPLICATE (MD): YES/NO NO

CO= LEL= OXY= H2S=

No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
1 - 250 ml plastic	NA	Y	~~Pump~~ Bailer 1	perchlorate

00915200

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 003 (54)	LocID: 128	Date: 9/22/16
	Project Name: Longhorn Army Ammunition Plant	Project #: 60256135	Recorded By: Beesinger Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: U-52 21168		Water Level Indicator Type/ID #: Solinst 101
	Equipment Group: NA		Equpment Group: NA
	Development Equipment: Hurricane Pump		Equipment Decon.: LIQUINOX & DI WATER
WELL INFO	Casing I.D. (in) [a]: 2"	Unit Casing Volume (gal/lin ft) [b]: 0.16	Initial Depth to Water (ft) [c]: 22.94
	Total Well Depth (ft) [d]: 35.08	Water Column Thickness (ft) [d-c]: 12.14	Well Volume (gal) {[d-c] x b}: 1.95
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	**2.0**	2.2	3.0	**4.0**	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	**0.16**	0.20	0.37	**0.65**	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Radiation ( )	Remarks (odor, clarity, etc.)
9/22/16	0930	Bailer	32.00	2	NA	19.80	6.42	3.85	9.21	843	79		
9/22/16	1011	Bailer	33.16	2	NA	21.63	6.87	3.72	8.99	10.3	7		
9/22/16	1050	Bailer	31.71	2	NA	21.32	6.91	3.66	8.84	6.7	3		
			Bailed 3 well volumes										

Development Criteria: **1)** sediment <0.75 mL/L, **2)** turbidity within 10 NTU range for 30 minutes, **3)** +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

00915201

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: 003 (54)	LocID: 127	Date: 9/22/16
	Project Name: Longhorn Army Ammunition Plant	Project #: 60256135	Recorded By: Beesinger Checked By:
EQUIPMENT	Water Quality Meter Type/ID #: U-52 HoriBA		Water Level Indicator Type/ID #: Solinst 101
	Equipment Group: NA		Equpment Group: NA
	Development Equipment: Bailer		Equipment Decon.: LIQUINOX & DI WATER
WELL INFO	Casing I.D. (in) [a]: 2 11	Unit Casing Volume (gal/lin ft) [b]: 0.16	Initial Depth to Water (ft) [c]: 16.44
	Total Well Depth (ft) [d]: 28.21	Water Column Thickness (ft) [d-c]: 11.77	Well Volume (gal) {[d-c] x b}: 1.88
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	**2.0**	2.2	3.0	**4.0**	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	**0.16**	0.20	0.37	**0.65**	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	ORP (mv)	Radiation ( )	Remarks (odor, clarity, etc.)
9/22/16	1245	Bail	20.00	2	NA	24.46	7.22	1.32	8.98	503	-60		
9/22/16	1305	Bail	22.21	2	NA	23.79	7.10	1.40	8.81	59.0	-70		
9/22/16	1325	Bail	23.17	2	NA	23.66	7.00	1.43	8.77	17.7	-76		
			BAILED 3 well volumes										

Development Criteria: **1)** sediment <0.75 mL/L, **2)** turbidity within 10 NTU range for 30 minutes, **3)** +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

NOVEMBER 2017 GROUNDWATER FIELD SAMPLING FORMS

00915203

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

LOCATION	Site: LHAAP - 001	Location ID: 27WW01	Date: 11/21/17
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba / 21354	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): SS / 4"	Unit Casing Volume (gal/lin ft) (A): 0.652	Initial Depth to Water (ft) (B): 16.91
	Total Well Depth (ft) (C): 30.50	Water Column Thickness (ft) (C-B): 13.59	Well Volume (gal) (A*(C-B)): 8.86
	Ambient PID (ppm): NA	Well Mouth PID (ppm): NA	System Volume (gal): NA
	Weather: CLEAR / COLD	Well Condition: ~~WELDS~~ PAINT	Comments: NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/21/17	1100	16.97	.13	100	18.24	5.98	7.18	0.83	8.6	227	
	1105	17.02	.26	100	18.53	5.85	7.01	0.70	9.7	231	
	1110	17.05	.39	100	18.62	5.79	6.92	0.50	10.6	238	
	1115	17.08	.52	100	18.75	5.59	6.83	0.37	10.7	252	
	1120	17.10	.65	100	18.79	5.58	6.83	0.36	10.5	253	
	1125	17.12	.78	100	18.83	5.57	6.82	0.35	10.4	254	
	1130	17.13	.91	100	18.85	5.56	6.82	0.35	10.2	254	

Colorimeter Results

Time	Analyte	Dilution	Result	Units

Conversions	**Stabilization Criteria**			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
	2	250mL plastic	NA	Y		PERCHLORATE
Sample ID: 27WW01-112117				Sample Time: 1130		

00915204

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

LOCATION	Site: LHAAP - 001	Location ID: 27WW02	Date: 11/20/17
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba / 21354	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): SS / 4"	Unit Casing Volume (gal/lin ft) (A): 0.652	Initial Depth to Water (ft) (B): 10.90
	Total Well Depth (ft) (C): 20.46	Water Column Thickness (ft) (C-B): 9.56	Well Volume (gal) (A*(C-B)): 6.23
	Ambient PID (ppm): NA	Well Mouth PID (ppm): NA	System Volume (gal): NA
	Weather: CLEAR / COOL	Well Condition: NEEDS PAINT	Comments:

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/20/17	1310	10.96	.13	100	18.74	5.77	8.32	1.96	82.5	229	
	1315	11.01	.26	100	19.04	5.56	8.50	0.90	63.5	242	
	1320	11.05	.39	100	19.30	5.42	8.57	0.45	48.0	265	
	1325	11.09	.52	100	19.55	5.33	8.59	0.20	38.4	270	
	1330	11.12	.65	100	19.57	5.32	8.59	0.20	38.0	271	
	1335	11.14	.78	100	19.59	5.32	8.60	0.19	37.6	272	
	1340	11.15	.91	100	19.60	5.31	8.60	0.19	37.1	272	

Colorimeter Results					No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
Time	Analyte	Dilution	Result	Units		1	250mL Plastic	NA	Y		PERCHLORATE

Conversions	Stabilization Criteria			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

Sample ID: 27WW02-112017 Sample Time: 1340

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

LOCATION	Site: LHAAP - 001	Location ID: 27WW03	Date: 11/21/17
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba / 21354	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): SS / 4"	Unit Casing Volume (gal/lin ft) (A): 0.652	Initial Depth to Water (ft) (B): 11.70
	Total Well Depth (ft) (C): 20.48	Water Column Thickness (ft) (C-B): 8.78	Well Volume (gal) (A*(C-B)): 5.72
	Ambient PID (ppm): NA	Well Mouth PID (ppm): NA	System Volume (gal): NA
	Weather: CLEAR / COLD	Well Condition: NEEDS PAINT	Comments: NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/21/17	1005	11.77	.13	100	17.85	4.98	6.09	1.39	11.3	270	
	1010	11.83	.26	100	18.29	4.71	6.02	0.53	0.0	329	
	1015	11.87	.39	100	18.53	4.59	6.00	0.40	0.0	350	
	1020	11.90	.52	100	18.97	4.41	6.00	0.12	0.0	366	
	1025	11.92	.65	100	19.02	4.40	6.01	0.11	0.0	367	
	1030	11.93	.78	100	19.05	4.40	6.01	0.10	0.0	368	
	1035	11.93	.91	100	19.09	4.40	6.01	0.10	0.0	369	

Colorimeter Results

Time	Analyte	Dilution	Result	Units

Conversions	**Stabilization Criteria**			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
	1	250 mL PLASTIC	NA	Y		PERCHLORATE

Sample ID: 27WW03_11217 Sample Time: 1035

00915206

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

LOCATION	Site: LHAAP - 001	Location ID: 27WW04	Date: 11/20/17
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba / 21354	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): SS / 4	Unit Casing Volume (gal/lin ft) (A): 0.652	Initial Depth to Water (ft) (B): 10.07
	Total Well Depth (ft) (C): 20.42	Water Column Thickness (ft) (C-B): 10.35	Well Volume (gal) (A*(C-B)): 6.75
	Ambient PID (ppm): NA	Well Mouth PID (ppm): NA	System Volume (gal):
	Weather: CLEAR / COOL	Well Condition: NEEDS PAINT	Comments: NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/20/17	1410	10.12	.13	100	19.26	5.35	8.46	1.68	91.0	235	
	1415	10.17	.26	100	19.45	5.25	8.48	0.38	75.4	244	
	1420	10.20	.39	100	19.49	5.21	8.49	0.22	57.3	250	
	1425	10.22	.52	100	19.50	5.12	8.49	0.15	57.0	267	
	1430	10.24	.65	100	19.51	5.11	8.49	0.14	56.7	268	
	1435	10.25	.78	100	19.52	5.11	8.49	0.14	56.5	268	
	1440	10.25	.91	100	19.52	5.11	8.49	0.14	56.3	269	

Colorimeter Results

Time	Analyte	Dilution	Result	Units

Conversions	**Stabilization Criteria**			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
	3	250 mL Plastic	NA	Y		PERCHLORATE

Sample ID: 27WW04-112017 Sample Time: 1440

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

LOCATION	Site: LHAAP - 001	Location ID: 131	Date: 11/21/17
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba / 21354	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): PVC / 2"	Unit Casing Volume (gal/lin ft) (A): 0.160	Initial Depth to Water (ft) (B): 13.26
	Total Well Depth (ft) (C): 18.40	Water Column Thickness (ft) (C-B): 5.14	Well Volume (gal) (A*(C-B)): 0.82
	Ambient PID (ppm): NA	Well Mouth PID (ppm): NA	System Volume (gal): NA
	Weather: CLEAR / COLD	Well Condition: NEEDS PAINT	Comments: NA

CASING INFO	Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
	Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/21/17	0805	13.32	.13	100	15.52	5.41	3.02	1.79	578	309	
	0810	13.37	.26	100	17.48	5.56	2.86	0.71	445	245	
	0815	13.40	.39	100	17.98	5.52	2.73	0.30	400	[redacted]121	
	0820	13.42	.52	100	18.50	5.53	259	0.09	300	80	
	0825	13.44	.65	100	18.54	5.53	2.58	0.09	299	81	
	0830	13.46	.78	100	18.58	5.53	2.57	0.08	298	82	
	0835	13.48	.91	100	18.61	5.54	2.57	0.08	297	82	

Colorimeter Results					No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
Time	Analyte	Dilution	Result	Units		1	250 mL Plastic	NA	Y		PERCHLORATE

Conversions	Stabilization Criteria					
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%		
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%		
	Cond	+/- 10%	ORP	+/- 10	Sample ID: 131-112117	Sample Time: 0835

00915208

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

LOCATION	Site: LHAAP - 001	Location ID: 132	Date: 11/21/17
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba / 21354	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): PVC / 2"	Unit Casing Volume (gal/lin ft) (A): 0.160	Initial Depth to Water (ft) (B): 12.08
	Total Well Depth (ft) (C): 27.43	Water Column Thickness (ft) (C-B): 15.35	Well Volume (gal) (A*(C-B)): 2.46
	Ambient PID (ppm): NA	Well Mouth PID (ppm): NA	System Volume (gal): NA
	Weather: CLEAR / COLD	Well Condition: NEEDS PAINT	Comments: NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/21/17	0900	12.15	.13	100	17.49	5.68	8.17	1.69	445	148	
	0905	12.20	.26	100	18.44	5.25	8.25	0.44	440	224	
	0910	12.22	.39	100	18.90	5.14	8.24	0.20	435	250	
	0915	12.24	.52	100	19.30	5.14	8.25	0.02	430	237	
	0920	12.25	.65	100	19.33	5.13	8.26	0.01	430	236	
	0925	12.25	.78	100	19.37	5.13	8.26	0.01	429	235	
	0930	12.25	.91	100	19.40	5.13	8.26	0.01	428	235	

Colorimeter Results

Time	Analyte	Dilution	Result	Units

Conversions	**Stabilization Criteria**			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
	1	250mL Plastic	NA	Y		PERCHLORATE

Sample ID: 132-112117 Sample Time: 0930

NOVEMBER 2018 GROUNDWATER FIELD SAMPLING FORMS

00915210

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

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LOCATION	Site: LHAAP - 001	Location ID: 27WW01	Date: 11/7/18
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): SS 4"	Unit Casing Volume (gal/lin ft) (A): 0.652	Initial Depth to Water (ft) (B): 13.56
	Total Well Depth (ft) (C): 30.56	Water Column Thickness (ft) (C-B): 17.00	Well Volume (gal) (A*(C-B)): 11.08
	Screened Interval: 20.00 - 30.00	Weather: OVERCAST / RAIN	Ambient PID (ppm): NA
	Pump placement: 25.00	Well Condition: NEEDS PAINT	Well Mouth PID (ppm): NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/7/18	1055	13.63	.13	100	17.65	5.62	6.68	0.86	42.4	318	
	1100	13.67	.26	100	17.88	5.67	7.62	0.25	19.6	254	
	1105	13.70	.39	100	17.88	5.67	7.64	0.06	18.5	242	
	1110	13.72	.52	100	17.89	5.67	7.64	0.06	18.0	241	
	1115	13.74	.65	100	17.90	5.67	7.64	0.05	17.8	240	
	1120	13.75	.78	100	17.95	5.67	7.65	0.05	17.1	239	

Colorimeter Results

Time	Analyte	Dilution	Result	Units

Conversions	**Stabilization Criteria**			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
	3	125 ml plastic	NA	Y		PERCHLORATE

Sample ID: 27WW01_110718 Sample Time: 1120

00915211

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

LOCATION	Site: LHAAP - 001	Location ID: 27WW02	Date: 11/7/18
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): SS 4"	Unit Casing Volume (gal/lin ft) (A): 0.652	Initial Depth to Water (ft) (B): 4.26
	Total Well Depth (ft) (C): 20.55	Water Column Thickness (ft) (C-B): 16.29	Well Volume (gal) (A*(C-B)): 10.62
	Screened Interval: 10.00 - 20.00	Weather: OVERCAST / RAIN	Ambient PID (ppm): NA
	Pump placement: 15.00	Well Condition: NEEDS PAINT	Well Mouth PID (ppm): NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/7/18	1155	4.33	.13	100	17.71	5.31	1.28	0.80	50.7	288	
	1200	4.38	.26	100	17.90	5.09	1.50	0.29	44.6	310	
	1205	4.41	.39	100	17.93	5.08	1.85	0.12	42.5	307	
	1210	4.43	.52	100	17.96	5.09	1.85	0.12	42.2	306	
	1215	4.45	.65	100	17.99	5.08	1.86	0.11	41.9	306	
	1220	4.46	.78	100	18.02	5.10	1.87	0.11	41.7	305	

Colorimeter Results					No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
Time	Analyte	Dilution	Result	Units		1	125 ml plastic	NA	Y		PERCHLORATE

Conversions	Stabilization Criteria			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

Sample ID: 27WW02_110718 Sample Time: 1220

00915212

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

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LOCATION	Site: LHAAP - 001	Location ID: 27WW03	Date: 11/6/18
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): SS 4"	Unit Casing Volume (gal/lin ft) (A): 0.652	Initial Depth to Water (ft) (B): 6.18
	Total Well Depth (ft) (C): 20.45	Water Column Thickness (ft) (C-B): 14.27	Well Volume (gal) (A*(C-B)): 9.30
	Screened Interval: 10.00 - 20.00	Weather: CLEAR / SUNNY	Ambient PID (ppm): NA
	Pump placement: 15.00	Well Condition:	Well Mouth PID (ppm): NA

CASING INFO										
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/6/18	1235	6.25	.13	100	22.01	4.23	4.77	2.03	5.6	339	
	1240	6.30	.26	100	20.56	4.17	4.80	1.81	4.2	316	
	1245	6.33	.39	100	20.53	4.12	4.80	1.66	3.9	316	
	1250	6.35	.52	100	20.50	4.11	4.80	1.65	3.7	315	
	1255	6.36	.65	100	20.48	4.11	4.79	1.62	4.5	315	
	1300	6.36	.78	100	20.46	4.11	4.79	1.60	4.1	315	

Colorimeter Results

Time	Analyte	Dilution	Result	Units

Conversions	**Stabilization Criteria**			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
	1	125 ml plastic	NA	Y		PERCHLORATE

Sample ID: 27WW03_110618

Sample Time: 1300

00915213

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

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LOCATION	Site: LHAAP - 001	Location ID: 27WW04	Date: 11/6/18
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): SS 4"	Unit Casing Volume (gal/lin ft) (A): 0.652	Initial Depth to Water (ft) (B): 3.26
	Total Well Depth (ft) (C): 20.45	Water Column Thickness (ft) (C-B): 17.19	Well Volume (gal) (A*(C-B)): 11.21
	Screened Interval: 10.00 - 20.00	Weather: CLEAR SUNNY	Ambient PID (ppm): NA
	Pump placement: 15.00	Well Condition: NEEDS PAINT	Well Mouth PID (ppm): NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/6/18	1330	3.31	.13	100	21.98	4.91	7.95	0.80	73.8	320	
	1335	3.35	.26	100	21.30	4.83	8.05	0.25	63.2	330	
	1340	3.38	.39	100	21.10	4.80	8.10	0.07	54.0	331	
	1345	3.40	.52	100	21.05	4.79	8.10	0.06	53.7	332	
	1350	3.42	.65	100	21.02	4.79	8.10	0.06	53.1	333	
	1355	3.43	.78	100	20.98	4.79	8.10	0.06	52.6	333	

Colorimeter Results

Time	Analyte	Dilution	Result	Units

Conversions	**Stabilization Criteria**			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
	2	125 ml plastic	NA	Y		PERCHLORATE

Sample ID: 27WW04-110618 Sample Time: 1355

00915214

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

Page 1 of 1

LOCATION	Site: LHAAP - 001	Location ID: 131	Date: 11/6/18
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): 2"	Unit Casing Volume (gal/lin ft) (A): 0.160	Initial Depth to Water (ft) (B): 7.25
	Total Well Depth (ft) (C): 18.20	Water Column Thickness (ft) (C-B): 10.95	Well Volume (gal) (A*(C-B)): 1.75
	Screened Interval: 3.50 - 18.50	Weather: CLEAR / SUNNY	Ambient PID (ppm): NA
	Pump placement: 11.00	Well Condition: NEEDS PAINT	Well Mouth PID (ppm): NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/6/18	1445	7.32	.13	100	20.33	5.36	1.92	0.80	132	302	
	1450	7.38	.26	100	20.20	5.33	1.91	0.24	115	241	
	1455	7.42	.39	100	20.18	5.34	1.90	0.08	106	230	
	1500	7.45	.52	100	20.16	5.35	1.89	0.08	105	229	
	1505	7.47	.65	100	20.15	5.35	1.89	0.08	104	228	
	1510	7.49	.78	100	20.14	5.35	1.89	0.07	103	227	

Colorimeter Results

Time	Analyte	Dilution	Result	Units

Conversions	**Stabilization Criteria**			
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%
	Cond	+/- 10%	ORP	+/- 10

No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
	1	125ml plastic	NA	Y		PERCHLORATE

Sample ID: 131-110618 Sample Time: 1510

00915215

bhate ENVIRONMENT INFRASTRUCTURE

GROUNDWATER SAMPLE COLLECTION FORM

LOCATION	Site: LHAAP - 001	Location ID: 132	Date: 11/6/18
	Project Name: LHAAP	Project No./Phase: NWO1312.0150	Recorded By: Scott Beesinger
EQUIPMENT	Pump Type/ID#: Bladder Pump / SamplePro	Water Quality Meter/ID#: U-52 Horiba	PID Type/ID#: NA
	Water Level Indicator Type/ID#: Solinist 101	Other Equipment/ID#: NA	Decon Method: Liquinox & DI water
	Tubing Type/Diameter (in): 1/4"	Other Equipment/ID#: NA	PPE: Level D
WELL INFO	Casing Type / ID (in): PVC 2"	Unit Casing Volume (gal/lin ft) (A): 0.160	Initial Depth to Water (ft) (B): 6.11
	Total Well Depth (ft) (C): 27.50	Water Column Thickness (ft) (C-B): 21.39	Well Volume (gal) (A*(C-B)): 3.42
	Screened Interval: 12.50 - 27.50	Weather: CLEAR / SUNNY	Ambient PID (ppm): NA
	Pump placement: 20.00	Well Condition: NEEDS PAINT	Well Mouth PID (ppm): NA

CASING INFO											
Casing ID (in)	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	8.0
Unit Casing Volume (gal/lin ft)	0.016	0.020	0.043	0.103	0.160	0.378	0.652	1.03	1.48	2.57

DATE	TIME (24 Hr)	Water Level (BTOC)	Volume Removed (Gals)	Pumping Rate (ml/min)	Temp (C)	pH	Cond (mS/cm)	DO (mg/l)	Turb (NTU)	ORP (mV)	Remarks (odor, clarity, etc.)
11/6/18	1535	6.19	.13	100	20.19	5.10	6.82	0.86	575	246	
	1540	6.25	.26	100	20.07	4.70	6.84	0.21	441	275	
	1545	6.28	.39	100	20.05	4.63	6.82	0.04	415	280	
	1550	6.30	.52	100	20.04	4.63	6.81	0.04	414	281	
	1555	6.32	.65	100	20.02	4.62	6.81	0.03	413	282	
	1600	6.33	.78	100	20.00	4.62	6.81	0.03	412	283	

Colorimeter Results					No. Containers/Volume/Type			Preserv.	Filter (Y/N)	Method	Parameter(s)
Time	Analyte	Dilution	Result	Units		1	125ml plastic	NA	Y		PERCHLORATE

Conversions	Stabilization Criteria					
1 L = 0.26 gals	Temp	+/- 10%	DO	+/- 10%		
1 gal = 3.79 L	pH	+/- 0.1	Turb	+/- 10%		
	Cond	+/- 10%	ORP	+/- 10	Sample ID: 132-110618	Sample Time: 1600

APPENDIX C

QUALITY CONTROL SUMMARY REPORTS

SEPTEMBER 2016 QUALITY CONTROL SUMMARY REPORT

QUALITY CONTROL SUMMARY REPORT
LHAAP-003-R (GROUND SIGNAL TEST AREA)
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Prepared For:

U.S. Army Corps of Engineers

Prepared By:

AECOM

AECOM Technical Services

December 2016

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List of Tables

1 INTRODUCTION

AECOM reviewed one data package from Microbac Laboratory Services, Marietta, OH. Groundwater samples were collected on September 28 and 29, 2016 at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. Data were reviewed for conformance to the requirements of the following guidance documents: Automated Data Review by Laboratory Data Consultants (ADR.net), United States Environmental Protection Agency (EPA) Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, (EPA, July 2002), and EPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review, (EPA, June 2001).

1.1 Intended Use of Data

The purpose of the groundwater sampling and analysis is to determine the presence or absence of perchlorate at concentrations above the Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL). Analyses requested included:

- SW6850 – Perchlorates by LC/MS/MS

Table 2 lists the sample identifications and their associated laboratory identifications.

1.2 Preservation and Holding Times

Sample identification data were evaluated for agreement with the chain-of-custody (COC). All samples were received in appropriate containers, within the proper temperature range, in good condition, and with the required signatures.

1.3 Calibrations

Initial calibration criteria modification includes RSD< or = to 30%, two compounds allowed up to 40%. If the continuing calibration verification (CCV) compound exceeds 30% drift, the compound is checked in the LCS, if both are outside recovery limits, the compound is rejected, R. If only the CCV exceeds recovery criteria and is less than ± 40% drift, then the compound is qualified J or UJ.

1.3.1 Continuing Calibration Verifications (CCV)

All CCVs were within control limits.

1.3.2 Blanks

Where contamination by a target analyte of one of the various blanks was found, if the sample result for an associated sample was non-detect or less than 5X (10X for common laboratory contaminants) the analyte concentration in the blank, the corresponding sample result for the analyte was qualified B. Where the sample result for the affected analyte was greater than 5X the amount in the blank, no qualifier was applied.

No blank contamination was found.

1.3.3 Surrogates

All surrogates were within control limits.

1.3.4 Laboratory Control Sample (LCS)

All LCS were within control limits.

1.3.5 Matrix Spike/ Matrix Spike Duplicate (MS/MSD)

The MS/MSD was within control limits.

1.3.6 Field Duplicate Precision

The field duplicate was within control limits.

2 DATA USABILITY SUMMARY

The data are usable for the intended purposes of the project. The data quality objectives have been met for the project.

Table 1: Completeness by Method

Method	Total Analytes	No. of Rejected Results	% Completeness
SW6850	6	0	100

Table 2: Field Sample Identification and Laboratory Identification

Client Sample ID	Lab Sample ID	Collected	SW6850
18WW16-092916	L16091386-01	09/29/2016	X
128-092916	L16091386-02	09/29/2016	X
128FD-092916	L16091386-03	09/29/2016	X
127-092916	L16091386-04	09/29/2016	X
127MS-092916	L16091386-05	09/29/2016	X
127MSD-092916	L16091386-06	09/29/2016	X

NOVEMBER 2017 QUALITY CONTROL SUMMARY REPORT

LHAAP Data Validated
November 2017

LHAAP Site 001-R-01 *Annual Perchlorate Sampling – November 2017*
Perchlorate (6850)

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1.0 INTRODUCTION

Bhate Environmental Associates, Inc. (Bhate) reviewed one data package from ALS Laboratory Group, Houston, TX which subcontracted the perchlorate analysis to ALS Laboratory Group in Salt Lake City, UT. Groundwater samples were collected on November 20 and 21, 2017, at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. Data were reviewed for conformance to the requirements of the following guidance documents: United States Environmental Protection Agency (USEPA) Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (USEPA, January 2017), USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, January 2017), and quality control (QC) specified in the Army Draft Basewide Uniform Federal Policy - Quality Assurance Project Plan (QAPP) (Bhate, November 2017). Laboratory QC samples followed method specific requirements of the Department of Defense (DoD) Quality System Manual, Version 5.1 (Appendix F of the Quality Systems Manual) (DoD, January 2017).

1.1 Intended Use of Data

The purpose of the groundwater sampling and analysis is to determine the presence or absence of perchlorate at concentrations above the Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL). Analyses requested included:

- SW6850 – Perchlorates by Liquid Chromatography (LC)/Mass Spectrometry (MS)

Table 1 lists the sample identifications and their associated laboratory identifications.

Table 1: Field Sample Identification and Laboratory Identification

Client Sample ID	Lab Sample ID	Collected	SW6850
27WW02_112017	HS17111261-01	11/20/17	X
27WW04_112017	HS17111261-02	11/20/17	X
131_112117	HS17111261-03	11/21/17	X
132_112117	HS17111261-04	11/21/17	X
27WW03_112117	HS17111261-05	11/21/17	X
27WW01_112117	HS17111261-06	11/21/17	X
27WW01_112117-a	HS17111261-07	11/21/17	X

1.2 Preservation and Holding Times

Sample identification (ID) data were evaluated for agreement with the chain of custody (COC). All samples were received in appropriate containers, within the proper temperature range, in good condition, and with the required signatures.

1.3 Initial Calibration Verification (ICV) and Continuing Calibration Verifications (CCV)

All analytes reported must be present in the initial and continuing calibration. All results reported must be within the calibration range. Samples will be diluted, if necessary, to bring analyte responses within the calibration range. A CCV will be performed daily before sample analysis,

unless an initial calibration (ICAL) and second-source standard verification is performed immediately before sample analysis, and as required by the method.

All initial and continuing calibration verifications were within control limits.

1.4 Blanks

If the sample result for an associated sample was less than 5 times the analyte concentration in the blank, the corresponding sample result for the analyte was qualified "UB" and considered an artifact of blank contamination. Where the sample result for the affected analyte was greater than 5 times the amount in the blank, no qualifier was applied.

No blank contamination was found.

1.5 Surrogates

Surrogates are added to all environmental samples, controls, and blanks in accordance with method requirements. Per method 6850, no surrogates are added. Therefore accuracy and precision are measured by the recovery of the laboratory control sample and matrix spike samples.

1.6 Laboratory Control Sample (LCS)

All LCS were within control limits.

1.7 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The project MS/MSD was within control limits.

1.8 Field Duplicate Precision

Both the sample and field duplicate reported no detections of perchlorate. Therefore, there was no requirement to calculate the relative percent different (RPD).

2.0 DATA USABILITY SUMMARY

The data are usable for the intended purposes of the project. The data quality objectives have been met for the project. The completeness goal of 95% has been exceeded as shown in Table 2 below.

Table 2: Completeness by Method

Method	Total Analytes	No. of Rejected Results	% Completeness
SW6850	6 (+ 1 field duplicate)	0	100

NOVEMBER 2018 QUALITY CONTROL SUMMARY REPORT

LHAAP Data Validated
November 2018

LHAAP Site 001-R-01 *Annual Perchlorate Sampling – November 2018*
Perchlorate (6850)

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List of Tables

1.0 INTRODUCTION

Bhate Environmental Associates, Inc. (Bhate) reviewed one data package from ALS Laboratory, Houston, TX which subcontracted the perchlorate analysis to ALS Laboratory in Salt Lake City, UT. Groundwater samples were collected on November 6 and 7, 2018, at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. Data were reviewed for conformance to the requirements of the following guidance documents: United States Environmental Protection Agency (USEPA) Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (USEPA, January 2017), USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, January 2017), and quality control (QC) specified in the Basewide Uniform Federal Policy - Quality Assurance Project Plan (QAPP) found in Appendix C of the Installation-wide Work Plan for LHAAP (Bhate, May 2018). Laboratory QC samples followed method specific requirements of the Department of Defense (DoD) Quality System Manual, Version 5.1 (Appendix F of the Quality Systems Manual) (DoD, January 2017).

1.1 Intended Use of Data

The purpose of the groundwater sampling and analysis is to determine the presence or absence of perchlorate at concentrations above the Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL). Analyses requested included:

- SW6850 – Perchlorates by Liquid Chromatography/Mass Selective Detector (LC/MSD)

Table 1 lists the sample identification (ID) numbers and their associated laboratory package.

Table 2 lists qualified results with the qualification flag and reason code.

The following narrative is a brief synopsis of data that required qualification due to QC discrepancies.

1.2 Preservation and Holding Times

Sample identification data were evaluated for agreement with the chain-of-custody (COC). All samples were received in appropriate containers, within the proper temperature range, in good condition, and with the required signatures.

1.3 Initial Calibration Verification (ICV) and Continuing Calibration Verifications (CCV)

All analytes reported must be present in the initial and continuing calibration. All results reported must be within the calibration range. Samples will be diluted, if necessary, to bring analyte responses within the calibration range. A CCV will be performed daily before sample analysis, unless an initial calibration and second-source standard verification is performed immediately before sample analysis, and as required by the method.

All initial and continuing calibration verifications were within control limits.

1.4 Blanks

If the sample result for an associated sample was less than 5X the analyte concentration in the blank, the corresponding sample result for the analyte was qualified "UB" and considered an artifact of blank contamination. Where the sample result for the affected analyte was greater than 5X the amount in the blank, no qualifier was applied.

No blank contamination was found.

1.5 Surrogates

Surrogates are added to all environmental samples, controls, and blanks in accordance with method requirements. Per method 6850, no surrogates are added. Therefore accuracy and precision are measured by the recovery of the laboratory control sample and matrix spike samples.

1.6 Laboratory Control Sample (LCS)

All LCS were within control limits.

1.7 Matrix Spike/ Matrix Spike Duplicate (MS/MSD)

The MS recovery was slightly below control limits (78.5%). The non-detect result was qualified as estimated and flagged "UJ" in parent sample 27WW01.

1.8 Field Duplicate Precision

Both the sample and field duplicate reported no detections of perchlorate. Therefore, there was no requirement to calculate the relative percent different (RPD).

2.0 DATA USABILITY SUMMARY

The data are usable for the intended purposes of the project (see Table 3). The data quality objectives have been met for the project.

Table 1: Field Sample Identification and Laboratory Identification

Client Sample ID	Lab Sample ID	Collected	SW6850
27WW03_110618	HS18110500-01	11/6/18	X
27WW04_110618	HS18110500-02	11/6/18	X
27WW04_110618a	HS18110500-03	11/6/18	X
131_110618	HS18110500-04	11/6/18	X
132_110618	HS18110500-05	11/6/18	X
27WW01_110718	HS18110500-06	11/7/18	X
27WW02_110718	HS18110500-07	11/7/18	X

Table 2: Qualified Analytical Data

Client Sample ID	Laboratory Package	Analyte Name	Data Validation Qualifier	Reason for Qualification
27WW01_110718	HS18110500-06	Perchlorate	< 2.0 UJ	MS <

Notes:
UJ – Estimated non-detect due to discrepancies in meeting certain analyte-specific quality control criteria.
MS <– Matrix spike recovery below control limits
HS - Houston

Table 3: Completeness by Method

Method	Total Analytes	No. of Rejected Results	% Completeness
SW6850	6 (+ 1 field duplicate)	0	100

APPENDIX D
LABORATORY ANALYTICAL REPORTS

SEPTEMBER 2016 LABORATORY ANALYTICAL REPORT

Microbac

Laboratory Report Number: L16091387

Kayla Teague
AECOM Technical Services, Inc.
1950 N Stemmons FWY
Dallas, TX 75207

Please find enclosed the analytical results for the samples you submitted to Microbac Laboratories. Review and compilation of your report was completed by Microbac's Ohio Valley Division (OVD). If you have any questions, comments, or require further assistance regarding this report, please contact your service representative listed below.

Laboratory Contact:
Adriane Steed – Client Services Specialist
(740) 373-4071
Adriane.Steed@microbac.com

I certify that all test results meet all of the requirements of the DoD QSM and other applicable contract terms and conditions. Any exceptions are attached to this cover page or addressed in the method narratives presented in the report. All results for soil samples are reported on a 'dry-weight' basis unless specified otherwise. Analytical results for water and wastes are reported on a 'as received' basis unless specified otherwise. A statement of uncertainty for each analysis is available upon request. This laboratory report shall not be reproduced, except in full, without the written approval of Microbac Laboratories, DoD ELAP certification number 2936.01. The reported results are related only to the samples analyzed as received.

This report was certified on October 13 2016

Leslie Bucina – Managing Director

State of Origin: TX
Accrediting Authority: Texas Commission on Environmental Quality ID:T104704252-07-TX
QAPP: DOD Ver 4.1

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Record of Sample Receipt and Inspection

Comments/Discrepancies

This is the record of the shipment conditions and the inspection records for the samples received and reported as a sample delivery group (SDG). All of the samples were inspected and observed to conform to our receipt policies, except as noted below.

There were no discrepancies.

Discrepancy	Resolution

Coolers

Cooler #	Temperature Gun	Temperature	COC #	Airbill #	Temp Required?
00114099	I	4.0		J4616883308	X

Inspection Checklist

#	Question	Result
1	Were shipping coolers sealed?	Yes
2	Were custody seals intact?	Yes
3	Were cooler temperatures in range of 0-6?	Yes
4	Was ice present?	Yes
5	Were COC's received/information complete/signed and dated?	Yes
6	Were sample containers intact and match COC?	Yes
7	Were sample labels intact and match COC?	Yes
8	Were the correct containers and volumes received?	Yes
9	Were samples received within EPA hold times?	Yes
10	All samples were checked for pH and met the standard. Exceptions are noted above under discrepancy. (water only)	Yes
11	Were pH ranges acceptable? (voa's excluded)	Yes
12	Were VOA samples free of headspace (less than 6mm)?	NA

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Samples Received

Client ID	Laboratory ID	Date Collected	Date Received
27WW01-092816	L16091387-01	09/28/2016 08:20	09/30/2016 10:11
27WW01MS-092816	L16091387-02	09/28/2016 08:20	09/30/2016 10:11
27WW01MSD-092816	L16091387-03	09/28/2016 08:20	09/30/2016 10:11
27WW03-092816	L16091387-04	09/28/2016 09:20	09/30/2016 10:11
132-092816	L16091387-05	09/28/2016 10:20	09/30/2016 10:11
132FD-092816	L16091387-06	09/28/2016 10:20	09/30/2016 10:11
131-092816	L16091387-07	09/28/2016 11:15	09/30/2016 10:11
27WW02-092816	L16091387-08	09/28/2016 13:25	09/30/2016 10:11
27WW04-092816	L16091387-09	09/28/2016 14:25	09/30/2016 10:11

Microbac REPORT L16091387
PREPARED FOR AECOM Technical Services, Inc.
WORK ID:

1.0 Summary Data

1.1 Narratives

Microbac

Texas Risk Reduction Program (TRRP) Checklist

Laboratory Name:	Microbac OVD	**Laboratory Log Number:**	L16091387
Project Name:		**Method:**	6850
Prep Batch Number(s):	WG586928	**Reviewer Name:**	Eric Lawson
LRC Date:	2016-10-13 00:00:00		

Laboratory Data Package Cover Page

X	R1	Field chain-of-custody documentation;
X	R2	Sample identification cross-reference;
X	R3	Test reports (analytical data sheets) for each environmental sample that includes: (a) Items consistent with NELAC Chapter 5, (b) dilution factors, (c) preparation methods, (d) cleanup methods, and (e) a.if required for the project, tentatively identified compounds (TICs).
X	R4	Surrogate recovery data including: (a) Calculated recovery (%R), and (b) the laboratory's surrogate QC limits.
X	R5	Test reports/summary forms for blank samples;
X	R6	Test reports/summary forms for laboratory control samples (LCSs) including: (a) LCS spiking amounts, (b) calculated %R for each analyte, and (c) the laboratory's LCS QC limits.
X	R7	Test reports for project matrix spike/matrix spike duplicates (MS/MSDs) including: (a) samples associated with the MS/MSD clearly identified, (b) MS/MSD spiking compounds, (c) concentration of each MS/MSD analyte measured in the parent and spiked samples, (d) calculated %Rs and relative percent differences (RPDs), and (e) the laboratory's MS/MSD QC limits.
X	R8	Laboratory analytical duplicate (if applicable) recovery and precision: (a) the amount of analyte measured in the duplicate, (b) the calculated RPD, and (c) the laboratory's QC limits for analytical duplicates.
X	R9	List of method quantitation limits (MQLs) and detectability check sample results for each analyte for each method and matrix.
X	R10	Other problems or anomalies.

Name (Printed)	Signature	Official Title (Printed)	Date
Eric Lawson		Chemist III	2016-10-13 12:41:42

Microbac

Texas Risk Reduction Program (TRRP) Checklist

Laboratory Name:	Microbac OVD	**Laboratory Log Number:**	L16091387
Project Name:		**Method:**	6850
Prep Batch Number(s):	WG586928	**Reviewer Name:**	Eric Lawson
LRC Date:	2016-10-13 00:00:00		

Description	Yes	No	NA	NR	ER#
Chain-of-custody (C-O-C)					
Did samples meet the laboratory's standard conditions of sample acceptability upon receipt?	X				
Were all departures from standard conditions described in an exception report?	X				
Sample and quality control (QC) identification	X				
Are all field sample ID numbers cross-referenced to the laboratory ID numbers?	X				
Are all laboratory ID numbers cross-referenced to the corresponding QC data?	X				
Test reports					
Were all samples prepared and analyzed within holding times?	X				
Other than those results < MQL, were all other raw values bracketed by calibration standards?	X				
Were calculations checked by a peer or supervisor?	X				
Were all analyte identifications checked by a peer or supervisor?	X				
Were sample detection limits reported for all analytes not detected?	X				
Were all results for soil and sediment samples reported on a dry weight basis?			X		
Were % moisture (or solids) reported for all soil and sediment samples?			X		
Were bulk soils/solids samples for volatile analysis extracted with methanol per SW846 Method 5035?			X		
If required for the project, are TICs reported?			X		
Surrogate recovery data					
Were surrogates added prior to extraction?			X		
Were surrogate percent recoveries in all samples within the laboratory QC limits?			X		
Test reports/summary forms for blank samples	X				
Were appropriate type(s) of blanks analyzed?	X				
Were blanks analyzed at the appropriate frequency?	X				
Were method blanks taken through the entire analytical process, including preparation and, if applicable, cleanup procedures?	X				
Were blank concentrations < MQL?	X				
Laboratory control samples (LCS):					
Were all COCs included in the LCS?	X				

Texas Risk Reduction Program (TRRP) Checklist

Laboratory Name:	Microbac OVD	**Laboratory Log Number:**	L16091387
Project Name:		**Method:**	6850
Prep Batch Number(s):	WG586928	**Reviewer Name:**	Eric Lawson
LRC Date:	2016-10-13 00:00:00		

Was each LCS taken through the entire analytical procedure, including prep and cleanup steps?	X				
Were LCSs analyzed at the required frequency?	X				
Were LCS (and LCSD, if applicable) %Rs within the laboratory QC limits?	X				
Does the detectability check sample data document the laboratory's capability to detect the COCs at the MDL used to calculate the SDLs?	X				
Was the LCSD RPD within QC limits?			X		
Matrix spike (MS) and matrix spike duplicate (MSD) data					
Were the project/method specified analytes included in the MS and MSD?	X				
Were MS/MSD analyzed at the appropriate frequency?	X				
Were MS (and MSD, if applicable) %Rs within the laboratory QC limits?	X				
Were MS/MSD RPDs within laboratory QC limits?	X				
Analytical duplicate data					
Were appropriate analytical duplicates analyzed for each matrix?			X		
Were analytical duplicates analyzed at the appropriate frequency?			X		
Were RPDs or relative standard deviations within the laboratory QC limits?			X		
Method quantitation limits (MQLs):					
Are the MQLs for each method analyte included in the laboratory data package?	X				
Do the MQLs correspond to the concentration of the lowest non-zero calibration standard?	X				
Are unadjusted MQLs and DCSs included in the laboratory data package?	X				
Other problems/anomalies					
Are all known problems/anomalies/special conditions noted in this LRC and ER?	X				
Was applicable and available technology used to lower the SDL to minimize the matrix interference effects on the sample results?	X				
Is the laboratory NELAC-accredited under the Texas Laboratory Accreditation Program for the analytes, matrices and methods associated with this laboratory data package?	X				
Initial calibration (ICAL)					
Were response factors and/or relative response factors for each analyte within QC limits?	X				
Were percent RSDs or correlation coefficient criteria met?	X				

Microbac

Texas Risk Reduction Program (TRRP) Checklist

Laboratory Name:	Microbac OVD	**Laboratory Log Number:**	L16091387
Project Name:		**Method:**	6850
Prep Batch Number(s):	WG586928	**Reviewer Name:**	Eric Lawson
LRC Date:	2016-10-13 00:00:00		

Was the number of standards recommended in the method used for all analytes?	X				
Were all points generated between the lowest and highest standard used to calculate the curve?	X				
Are ICAL data available for all instruments used?	X				
Has the initial calibration curve been verified using an appropriate second source standard?	X				
Initial and continuing calibration verification (ICCV and CCV) and continuing calibration blank (CCB):					
Was the CCV analyzed at the method-required frequency?	X				
Were percent differences for each analyte within the method-required QC limits?	X				
Was the ICAL curve verified for each analyte?	X				
Was the absolute value of the analyte concentration in the inorganic CCB < MDL?			X		
Mass spectral tuning					
Was the appropriate compound for the method used for tuning?	X				
Were ion abundance data within the method-required QC limits?	X				
Internal standards (IS)					
Were IS area counts and retention times within the method-required QC limits?	X				
Raw data (NELAC Section 5.5.10)					
Were the raw data (for example, chromatograms, spectral data) reviewed by an analyst?	X				
Were data associated with manual integrations flagged on the raw data?	X				
Dual column confirmation					
Did dual column confirmation results meet the method-required QC?			X		
Tentatively identified compounds (TICs)					
If TICs were requested, were the mass spectra and TIC data subject to appropriate checks?			X		
Interference Check Sample (ICS) results					
Were percent recoveries within method QC limits?			X		
Serial dilutions, post digestion spikes, and method of standard additions					
Were percent differences, recoveries, and the linearity within the QC limits specified in the method?			X		
Method detection limit (MDL) studies					

Microbac

Texas Risk Reduction Program (TRRP) Checklist

Laboratory Name:	Microbac OVD	**Laboratory Log Number:**	L16091387
Project Name:		**Method:**	6850
Prep Batch Number(s):	WG586928	**Reviewer Name:**	Eric Lawson
LRC Date:	2016-10-13 00:00:00		

Was a MDL study performed for each reported analyte?	X				
Is the MDL either adjusted or supported by the analysis of DCSs?	X				
Proficiency test reports					
Was the laboratory's performance acceptable on the applicable proficiency tests or evaluation studies?	X				
Standards documentation					
Are all standards used in the analyses NIST-traceable or obtained from other appropriate sources?	X				
Compound/analyte identification procedures					
Are the procedures for compound/analyte identification documented?	X				
Demonstration of analyst competency (DOC)					
Was DOC conducted consistent with NELAC Chapter 5?	X				
Is documentation of the analyst's competency up-to-date and on file?	X				
Verification/validation documentation for methods (NELAC Chapter 5)					
Are all the methods used to generate the data documented, verified, and validated, where applicable?	X				
Laboratory standard operating procedures (SOPs)					
Are laboratory SOPs current and on file for each method performed	X				

1. Items identified by the letter “R” must be included in the laboratory data package submitted in the TRRP-required report(s). Items identified by the letter “S” should be retained and made available upon request for the appropriate retention period;

2. O = organic analyses; I = inorganic analyses (and general chemistry, when applicable);

3. NA = Not applicable;

4. NR = Not reviewed;

5. ER# = Exception Report identification number (an Exception Report should be completed for an item if “NR” or “No” is checked).

The Exception Report for each “No” or “Not Reviewed (NR)” item in Laboratory Review Checklist and for each analyte, matrix, and method for which the laboratory does not hold NELAC accreditation under the Texas Laboratory Accreditation Program.

Release Statement: I am responsible for the release of this laboratory data package. This laboratory is NELAC accredited under the Texas Laboratory Accreditation Program for all the methods, analytes, and matrices reported in this data package except as noted in the Exception Reports. The data have been reviewed and are technically compliant with the requirements of the methods used, except where noted by the laboratory in the Exception Reports. By my signature

Texas Risk Reduction Program (TRRP) Checklist

Laboratory Name:	Microbac OVD	**Laboratory Log Number:**	L16091387
Project Name:		**Method:**	6850
Prep Batch Number(s):	WG586928	**Reviewer Name:**	Eric Lawson
LRC Date:	2016-10-13 00:00:00		

below, I affirm to the best of my knowledge all problems/anomalies observed by the laboratory have been identified in the Laboratory Review Checklist, and no information affecting the quality of the data has been knowingly withheld.

Check, if applicable: [ ] This laboratory meets an exception under 30 TAC §25.6 and was last inspection by [ ] TCEQ or [ ] _____ on **(enter date of last inspection**). Any findings affecting the data in this laboratory data package are noted in the Exception Reports herein. The official signing the cover page of the report in which these data are used is responsible for releasing this data package and is by signature affirming the above release statement is true.

Exceptions Report

There are no exceptions.

1.2 Certificate of Analysis

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-01	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW01-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 19:13
Collect Date:	09/28/2016 08:20	**Dilution:**	1	**File ID:**	1LM.LM37314
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-02	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW01MS-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 19:32
Collect Date:	09/28/2016 08:20	**Dilution:**	1	**File ID:**	1LM.LM37315
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.213	J	0.400	0.200	0.100

J	Estimated value ; the analyte concentration was less than the LOQ.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-03	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW01MSD-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 19:51
Collect Date:	09/28/2016 08:20	**Dilution:**	1	**File ID:**	1LM.LM37316
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.207	J	0.400	0.200	0.100

J	Estimated value ; the analyte concentration was less than the LOQ.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-04	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW03-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 20:10
Collect Date:	09/28/2016 09:20	**Dilution:**	1	**File ID:**	1LM.LM37317
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-05	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	132-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 20:29
Collect Date:	09/28/2016 10:20	**Dilution:**	1	**File ID:**	1LM.LM37318
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-06	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	132FD-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 20:48
Collect Date:	09/28/2016 10:20	**Dilution:**	1	**File ID:**	1LM.LM37319
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-07	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	131-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 21:07
Collect Date:	09/28/2016 11:15	**Dilution:**	1	**File ID:**	1LM.LM37320
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-08	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW02-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 21:26
Collect Date:	09/28/2016 13:25	**Dilution:**	1	**File ID:**	1LM.LM37321
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.705		0.400	0.200	0.100

Certificate of Analysis

Sample #:	L16091387-09	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW04-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 21:44
Collect Date:	09/28/2016 14:25	**Dilution:**	1	**File ID:**	1LM.LM37322
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

2.0 Full Sample Data Package

2.1 General Chromatography Data

2.1.1 6850 LC/MS Data

2.1.1.1 Summary Data

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-01	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW01-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 19:13
Collect Date:	09/28/2016 08:20	**Dilution:**	1	**File ID:**	1LM.LM37314
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-02	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW01MS-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 19:32
Collect Date:	09/28/2016 08:20	**Dilution:**	1	**File ID:**	1LM.LM37315
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.213	J	0.400	0.200	0.100

J	Estimated value ; the analyte concentration was less than the LOQ.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-03	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW01MSD-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 19:51
Collect Date:	09/28/2016 08:20	**Dilution:**	1	**File ID:**	1LM.LM37316
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.207	J	0.400	0.200	0.100

J	Estimated value ; the analyte concentration was less than the LOQ.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-04	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW03-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 20:10
Collect Date:	09/28/2016 09:20	**Dilution:**	1	**File ID:**	1LM.LM37317
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-05	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	132-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 20:29
Collect Date:	09/28/2016 10:20	**Dilution:**	1	**File ID:**	1LM.LM37318
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-06	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	132FD-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 20:48
Collect Date:	09/28/2016 10:20	**Dilution:**	1	**File ID:**	1LM.LM37319
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-07	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	131-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 21:07
Collect Date:	09/28/2016 11:15	**Dilution:**	1	**File ID:**	1LM.LM37320
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

Certificate of Analysis

Sample #:	L16091387-08	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW02-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 21:26
Collect Date:	09/28/2016 13:25	**Dilution:**	1	**File ID:**	1LM.LM37321
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.705		0.400	0.200	0.100

Certificate of Analysis

Sample #:	L16091387-09	**PrePrep Method:**	N/A	**Instrument:**	LCMS1
Client ID:	27WW04-092816	**Prep Method:**	6850	**Prep Date:**	10/10/2016 14:00
Matrix:	Water	**Analytical Method:**	6850	**Cal Date:**	05/03/2016 17:18
Workgroup #:	WG586928	**Analyst:**	JWR	**Run Date:**	10/10/2016 21:44
Collect Date:	09/28/2016 14:25	**Dilution:**	1	**File ID:**	1LM.LM37322
Sample Tag:	01	**Units:**	ug/L		

Analyte	CAS #	Result	Qual	LOQ	LOD	DL
Perchlorate	14797-73-0	0.200	U	0.400	0.200	0.100

U	Analyte was not detected. The concentration is below the reported LOD.

Microbac

Lab Report #: L16091387
Lab Project #: 2551.096
Project Name: Longhorn Army Ammunition
Lab Contact: Adriane Steed

2.1.1.2 QC Summary Data

Example Calculation 6850 - Perchlorate

Concentration from Linear Regression

Step 1: Retrieve Curve Data From Plot, y = mx + b

y = response ratio = response of analyte / response of internal standard (IS) = Rx/Ristd

x = amount ratio = concentration analyte/concentration internal standard (IS) = Cx / Cistd

m = slope from curve (1.45)

b = intercept from curve (-0.00242)

y = 1.45x + -0.00242

Step 2: Substitute the value for y

where y = 12600/226000 = 0.055752

Step 3: Solve for x

x = (y - b)/m = 0.0040119

Step 4: Solve for analyte concentration Cx

Cx = (Cis)(x) = (5 ug/L)(0.040119) = 0.200594 ug/L

Example Calculation - Water:

Slope from curve, m:	1.45
Intercept from curve, b:	-0.00242
Response of analyte, Rx:	12600
Response of Internal Standard , Ristd:	226000
Concentration of IS, Cistd (ug/L):	5.00
Response Ratio:	0.05575
Amount Ratio:	0.04012
Analyte Concentration, Cx (ug/L) :	0.200594

Example Calculation - Soil:

Analyte Concentration, Cx (ug/L):	0.20059
Amount of soil extracted (g):	5.00
Final volume of extract (mL):	50.00
Percent solids (Pct wt.)	100
Concentration in soil (ug/kg):	2.005938

Perchlorate Conductivity Check
(perchlorate1)

Conductivity Probe Calibration Check: 1331 /1410 µs/cm

Working MCT Level: 10,000 µs/cm

Sample	Conductivity (µs/cm)	Pretreatment or Dilution Needed
WG586928-01 MCT	9,350.	
-02 Blank	0.41	
-03 LCS	0.50	
L16091386-01	6,450	
-02	4,630	
-03	4,690	
-04 RS	1,331	
-05 MS	1,361	
-06 MSD	1,356	
L16091387-01 RS	5,360	
-02 MS	5,430	
-03 MSD	5,430	
-04	4,320	
-05	8,470	
-06	8,580	
-07	8,570	
-08	8,760	
-09	9,170	
JWR ~~L1609~~ L16100095-01	2,990	
-02	2,910	

Analyst: John Richards

Date/Time: 10/11/16 / 12:50

DCN#121445

Microbac Laboratories Inc.

Instrument Run Log

Instrument: LCMS1 Dataset: 050316_JWR.TXT

Analyst1: JWR Analyst2: NA

Method: 6850 SOP: HPLC06 Rev: 8

Maintenance Log ID: Syringe Filter Lot#: 151125254

Eluent ID#:

Column 1 ID: KP-RPPX250 Column 2 ID: NA

Workgroups: Analytical WG567013 (soils)

Internal STD: COA18071 Surrogate STD: NA Calibration STD STD75510 (05/03/2016)

CCV STD: STD75510 LCS STD: STD75512 MS/MSD STD: STD75512

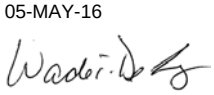
Comments: ICAL WG567320 : Alternate Source STD75512
Analytical Column : RPPX 5um (250x4.6mm)
K'Prime S/N RPPX250-02115

Samples L16041363(-05 and -10) were analyzed at dilutions based on their pre-run screen results.

Seq.	File ID	Sample Information	Mat	Dil	Reference	Date/Time
1	1LM.LM34686	WG567320-01 CCB	1	1		05/03/16 15:06
2	1LM.LM34687	WG567320-02 STD (0.1 ug/L)	1	1	STD75510	05/03/16 15:25
3	1LM.LM34688	WG567320-03 STD (0.2 ug/L)	1	1	STD75510	05/03/16 15:43
4	1LM.LM34689	WG567320-04 STD (0.5 ug/L)	1	1	STD75510	05/03/16 16:02
5	1LM.LM34690	WG567320-05 STD (1.0 ug/L)	1	1	STD75510	05/03/16 16:21
6	1LM.LM34691	WG567320-06 STD (2.0 ug/L)	1	1	STD75510	05/03/16 16:40
7	1LM.LM34692	WG567320-07 STD (5.0 ug/L)	1	1	STD75510	05/03/16 16:59
8	1LM.LM34693	WG567320-08 STD (10 ug/L)	1	1	STD75510	05/03/16 17:18
9	1LM.LM34694	WG567320-09 SSCV (1.0 ug/L)	1	1	STD75512	05/03/16 17:37
10	1LM.LM34695	WG567321-01 CCB	1	1		05/03/16 17:56
11	1LM.LM34696	WG567321-02 CCV (1.0ug/L)	1	1	STD75510	05/03/16 18:15
12	1LM.LM34697	WG567013-07 MRL (2.0ug/kg)	7	1	STD75510	05/03/16 18:34
13	1LM.LM34698	WG567013-01 MCT (2.0ug/kg)	7	1	STD75512	05/03/16 18:53
14	1LM.LM34699	WG567013-02 BLANK	7	1		05/03/16 19:12
15	1LM.LM34700	WG567013-03 LCS (2.0ug/kg)	7	1	STD75512	05/03/16 19:31
16	1LM.LM34701	L16041363-07 RS	7	1		05/03/16 19:50
17	1LM.LM34702	L16041363-08 MS	7	1	STD75512	05/03/16 20:09
18	1LM.LM34703	L16041363-09 MSD	7	1	STD75512	05/03/16 20:28
19	1LM.LM34704	L16041363-01	7	1		05/03/16 20:46
20	1LM.LM34705	L16041363-02	7	1		05/03/16 21:05
21	1LM.LM34706	L16041363-03	7	1		05/03/16 21:24
22	1LM.LM34707	L16041363-04	7	1		05/03/16 21:43
23	1LM.LM34708	WG567321-03 CCV (1.0ug/L)	1	1	STD75510	05/03/16 22:02
24	1LM.LM34709	WG567013-08 MRL (2.0ug/kg)	7	1	STD75510	05/03/16 22:21
25	1LM.LM34710	WG567321-04 CCB	1	1		05/03/16 22:40
26	1LM.LM34711	L16041363-05 (5x)	7	5		05/03/16 22:59
27	1LM.LM34712	L16041363-06	7	1		05/03/16 23:18
28	1LM.LM34713	L16041363-10 (5x)	7	5		05/03/16 23:37
29	1LM.LM34714	WG567321-05 CCV (1.0ug/L)	1	1	STD75510	05/03/16 23:56
30	1LM.LM34715	WG567013-09 MRL (2.0ug/kg)	7	1	STD75510	05/04/16 00:15
31	1LM.LM34716	WG567321-06 CCB	1	1		05/04/16 00:34

Comments

Page: 1 Approved: 05-MAY-16



Microbac Laboratories Inc.

Instrument Run Log

Instrument: LCMS1 Dataset: 050316_JWR.TXT

Analyst1: JWR Analyst2: NA

Method: 6850 SOP: HPLC06 Rev: 8

Maintenance Log ID: Syringe Filter Lot#: 151125254

Eluent ID#:

Workgroups: Column 1 ID: KP-RPPX250 Column 2 ID: NA

Analytical WG567013 (soils)

Internal STD: COA18071 Surrogate STD: NA STD75510 (05/03/2016)

CCV STD: STD75510 LCS STD: STD75512 STD75512

Comments

Seq.	Rerun	Dil.	Reason	Analytes
17				
	L16041363-08 MS : The MS %Rec is 129%. This is above the advisory limit of 120%. The parent sample to this MS had responses that passed the ion-ratio criteria, but had a quantified value below the method's detection limit, resulting in an assigned value of zero. If the quantified value for the parent sample were used in the %Rec calculation, the MS %Rec would be 93.9%.			
18				
	L16041363-09 MSD : The MSD %Rec is 131%. This is above the advisory limit of 120%. The parent sample to this MSD had responses that passed the ion-ratio criteria, but had a quantified value below the method's detection limit, resulting in an assigned value of zero. If the quantified value for the parent sample were used in the %Rec calculation, the MSD %Rec would be 95.4%.			

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Microbac Laboratories Inc.

Instrument Run Log

Instrument: LCMS1 Dataset: 101016_JWR.TXT

Analyst1: JWR Analyst2: NA

Method: 6850 SOP: HPLC06 Rev: 8

Maintenance Log ID: Syringe Filter Lot#: 160109254

Eluent ID#:

Column 1 ID: KP-RPPX250 Column 2 ID: NA

Workgroups: Analytical WG586928 (waters)

Internal STD: STD18071 Surrogate STD: NA Calibration STD STD75510 (05/03/2016)

CCV STD: STD78249 LCS STD: STD78251 MS/MSD STD: STD78251

Comments: Sample L16091386-01 was analyzed at a 2x dilution only due to its pre-run screen result for perchlorate.

Seq.	File ID	Sample Information	Mat	Dil	Reference	Date/Time
1	1LM.LM37298	WG586942-01 CCB	1	1		10/10/16 14:10
2	1LM.LM37299	WG586942-02 CCV (1.0ug/L)	1	1	STD78249	10/10/16 14:29
3	1LM.LM37300	WG586928-10 MRL (0.2ug/L)	1	1	STD78249	10/10/16 14:48
4	1LM.LM37301	WG586928-01 MCT (0.2ug/L)	1	1	STD78251	10/10/16 15:07
5	1LM.LM37302	WG586928-02 BLANK	1	1		10/10/16 15:26
6	1LM.LM37303	WG586928-03 LCS (0.2ug/L)	1	1	STD78251	10/10/16 15:45
7	1LM.LM37304	L16091386-04 RS	1	1		10/10/16 16:04
8	1LM.LM37305	L16091386-05 MS	1	1	STD78251	10/10/16 16:22
9	1LM.LM37306	L16091386-06 MSD	1	1	STD78251	10/10/16 16:41
10	1LM.LM37307	L16091386-01 (2x)	1	2		10/10/16 17:00
11	1LM.LM37308	L16091386-02	1	1		10/10/16 17:19
12	1LM.LM37309	L16091386-03	1	1		10/10/16 17:38
13	1LM.LM37310	L16100095-01	1	1		10/10/16 17:57
14	1LM.LM37311	WG586942-03 CCV (1.0ug/L)	1	1	STD78249	10/10/16 18:16
15	1LM.LM37312	WG586928-11 MRL (0.2ug/L)	1	1	STD78249	10/10/16 18:35
16	1LM.LM37313	WG586942-04 CCB	1	1		10/10/16 18:54
17	1LM.LM37314	L16091387-01 RS	1	1		10/10/16 19:13
18	1LM.LM37315	L16091387-02 MS	1	1	STD78251	10/10/16 19:32
19	1LM.LM37316	L16091387-03 MSD	1	1	STD78251	10/10/16 19:51
20	1LM.LM37317	L16091387-04	1	1		10/10/16 20:10
21	1LM.LM37318	L16091387-05	1	1		10/10/16 20:29
22	1LM.LM37319	L16091387-06	1	1		10/10/16 20:48
23	1LM.LM37320	L16091387-07	1	1		10/10/16 21:07
24	1LM.LM37321	L16091387-08	1	1		10/10/16 21:26
25	1LM.LM37322	L16091387-09	1	1		10/10/16 21:44
26	1LM.LM37323	L16100095-02	1	1		10/10/16 22:03
27	1LM.LM37324	WG586942-05 CCV (1.0ug/L)	1	1	STD78249	10/10/16 22:22
28	1LM.LM37325	WG586928-12 MRL (0.2ug/L)	1	1	STD78249	10/10/16 22:41
29	1LM.LM37326	WG586942-06 CCB	1	1		10/10/16 23:00

Comments

Seq.	Rerun	Dil.	Reason	Analytes

Page: 1 Approved: 11-OCT-16

Microbac Laboratories Inc.

Data Checklist

Date: 03-MAY-2016
Analyst: JWR
Analyst: NA
Method: 6850
Instrument: LCMS1
Curve Workgroup: WG567320
Runlog ID: 74891
Analytical Workgroups: L16041363 (SOILS)

ANALYTICAL	
System Performance Check	NA
DFTPP (GCMS)	NA
Endrin/DDT breakdown (8081/GCMS)	NA
Pentachlorophenol/benzidine tailing (GCMS)	NA
Eluent check (IC)/system pressure (HPLC)	NA
Window standard (FID)	NA
Initial Calibration	X
Average RF	NA
Linear regression or higher order curve	X
Alternate source standard (ICV) % Difference	X
Continuing Calibration (CCV)	X
% D/% Drift	X
Minimum response factors (GCMS)	X
Continuing calibration blank (CCB) (IC/LCMS)	X
Limit of quantitation verification (LOQV) (LCMS)	X
Special standards	NA
Blanks	X
TCL hits	ND
Surrogate recoveries	NA
LCS/LCSD (Laboratory Control Sample)	X
Recoveries	X
Surrogate recoveries	NA
MS/MSD/Sample duplicates	X
Recoveries	X
%RPD	X
Interference check sample (ICS) (LCMS)	MCT
Samples	X
TCL hits	X
Mass spectra (MS/HPLC)/2nd column confirmations (ECD/FID/HPLC)	NA
Surrogate recoveries	NA
Internal standard areas (MS)	X
Library searches (GCMS)	NA
Calculations & correct factors	X
Compounds above calibration range	NA
Reruns	NA
Manual integrations	NA
Project/client specific requirements	X
REPORTING	
Upload batch form	X
KOBRA workgroup data/forms/bench sheets	X
Case narratives	
Check for completeness	X
Primary Reviewer	JWR
SUPERVISORY/SECONDARY REVIEW	
Check for compliance with method and project specific requirements	X
Check the completeness/accuracy of reported information	X
Data qualifiers	X
Secondary Reviewer	WTD

Primary Reviewer:
04-MAY-2016

John Richards

Secondary Reviewer:
05-MAY-2016

Wadei D

CHECKLIST1 - Modified 03/05/2008
Generated: MAY-05-2016 16:23:46

Microbac Laboratories Inc.

Data Checklist

Date: 10-OCT-2016
Analyst: JWR
Analyst: NA
Method: 6850
Instrument: LCMS1
Curve Workgroup: NA
Runlog ID: 77980
Analytical Workgroups: L16091386, 1387 L16100095

ANALYTICAL	
System Performance Check	NA
DFTPP (GCMS)	NA
Endrin/DDT breakdown (8081/GCMS)	NA
Pentachlorophenol/benzidine tailing (GCMS)	NA
Eluent check (IC)/system pressure (HPLC)	NA
Window standard (FID)	NA
Initial Calibration	NA
Average RF	NA
Linear regression or higher order curve	NA
Alternate source standard (ICV) % Difference	NA
Continuing Calibration (CCV)	X
% D/% Drift	X
Minimum response factors (GCMS)	X
Continuing calibration blank (CCB) (IC/LCMS)	X
Limit of quantitation verification (LOQV) (LCMS)	X
Special standards	NA
Blanks	X
TCL hits	ND
Surrogate recoveries	NA
LCS/LCSD (Laboratory Control Sample)	X
Recoveries	X
Surrogate recoveries	NA
MS/MSD/Sample duplicates	X
Recoveries	X
%RPD	X
Interference check sample (ICS) (LCMS)	MCT
Samples	X
TCL hits	X
Mass spectra (MS/HPLC)/2nd column confirmations (ECD/FID/HPLC)	NA
Surrogate recoveries	NA
Internal standard areas (MS)	X
Library searches (GCMS)	NA
Calculations & correct factors	X
Compounds above calibration range	NA
Reruns	NA
Manual integrations	X
Project/client specific requirements	X
REPORTING	
Upload batch form	X
KOBRA workgroup data/forms/bench sheets	X
Case narratives	
Check for completeness	X
Primary Reviewer	JWR
SUPERVISORY/SECONDARY REVIEW	
Check for compliance with method and project specific requirements	X
Check the completeness/accuracy of reported information	X
Data qualifiers	X
Secondary Reviewer	MES

Primary Reviewer: 11-OCT-2016 John Richards

Secondary Reviewer: 11-OCT-2016 Mary Schilling

CHECKLIST1 - Modified 03/05/2008
Generated: OCT-11-2016 15:28:37

HOLDING TIMES
EQUIVALENT TO AFCEE FORM 9

Analytical Method: 6850 AAB#: WG586928

Login Number: L16091387

Client ID	ID	Date Collected	TCLP Date	Time Held	Max Hold	Q	Extract Date	Time Held	Max Hold	Q	Run Date	Time Held	Max Hold	Q
27WW01-092816	01	09/28/16					10/10/2016	12.2	28		10/10/16	.2	28	
27WW01MS-092816	02	09/28/16					10/10/2016	12.2	28		10/10/16	.2	28	
27WW01MSD-092816	03	09/28/16					10/10/2016	12.2	28		10/10/16	.2	28	
27WW03-092816	04	09/28/16					10/10/2016	12.2	28		10/10/16	.3	28	
132-092816	05	09/28/16					10/10/2016	12.2	28		10/10/16	.3	28	
132FD-092816	06	09/28/16					10/10/2016	12.2	28		10/10/16	.3	28	
131-092816	07	09/28/16					10/10/2016	12.1	28		10/10/16	.3	28	
27WW02-092816	08	09/28/16					10/10/2016	12	28		10/10/16	.3	28	
27WW04-092816	09	09/28/16					10/10/2016	12	28		10/10/16	.3	28	

* = SEE PROJECT QAPP REQUIREMENTS

HOLD_TIMES - Modified 03/06/2008
PDF File ID: 4970235
Report generated 10/11/2016 16:13

METHOD BLANK SUMMARY

Login Number: L16091387
Blank File ID: 1LM.LM37302
Prep Date: 10/10/16 14:00
Analyzed Date: 10/10/16 15:26
Analyst: JWR

Work Group: WG586928
Blank Sample ID: WG586928-02
Instrument ID: LCMS1
Method: 6850

This Method Blank Applies To The Following Samples:

Client ID	Lab Sample ID	Lab File ID	Time Analyzed	TAG
QCMRL	WG586928-10	1LM.LM37300	10/10/16 14:48	01
MCT	WG586928-01	1LM.LM37301	10/10/16 15:07	01
LCS	WG586928-03	1LM.LM37303	10/10/16 15:45	01
QCMRL	WG586928-11	1LM.LM37312	10/10/16 18:35	01
27WW01-092816	L16091387-01	1LM.LM37314	10/10/16 19:13	01
27WW01MS-092816	L16091387-02	1LM.LM37315	10/10/16 19:32	01
27WW01MSD-092816	L16091387-03	1LM.LM37316	10/10/16 19:51	01
27WW03-092816	L16091387-04	1LM.LM37317	10/10/16 20:10	01
132-092816	L16091387-05	1LM.LM37318	10/10/16 20:29	01
132FD-092816	L16091387-06	1LM.LM37319	10/10/16 20:48	01
131-092816	L16091387-07	1LM.LM37320	10/10/16 21:07	01
27WW02-092816	L16091387-08	1LM.LM37321	10/10/16 21:26	01
27WW04-092816	L16091387-09	1LM.LM37322	10/10/16 21:44	01
QCMRL	WG586928-12	1LM.LM37325	10/10/16 22:41	01

Report Name: BLANK_SUMMARY
PDF File ID: 4970236
Report generated 10/11/2016 16:13

Microbac Laboratories Inc.
METHOD BLANK REPORT

Login Number: L16091387 Prep Date: 10/10/16 14:00 Sample ID: WG586928-02
Instrument ID: LCMS1 Run Date: 10/10/16 15:26 Prep Method: 6850
File ID: 1LM.LM37302 Analyst: JWR Method: 6850
Workgroup (AAB#): WG586928 Matrix: Water Units: ug/L
Contract #: Cal ID: LCMS1-03-MAY-16

Analytes	DL	LOQ	Concentration	Dilution	Qualifier
Perchlorate	0.100	0.400	0.100	1	U

DL Method Detection Limit
LOQ Reporting/Practical Quantitation Limit
ND Analyte Not detected at or above reporting limit
* |Analyte concentration| > 1/2 RL

Report Name:BLANK
PDF ID: 4970237
11-OCT-2016 16:13

Microbac Laboratories Inc.
LABORATORY CONTROL SAMPLE (LCS)

Login Number: L16091387 **Run Date:** 10/10/2016 **Sample ID:** WG586928-03
Instrument ID: LCMS1 **Run Time:** 15:45 **Prep Method:** 6850
File ID: 1LM.LM37303 **Analyst:** JWR **Method:** 6850
Workgroup (AAB#): WG586928 **Matrix:** Water **Units:** ug/L
QC Key: DOD4 **Lot#:** STD78251 **Cal ID:** LCMS1-03-MAY-16

Analytes	Expected	Found	% Rec	LCS Limits	Q
Perchlorate	0.200	0.183	91.5	80 - 120	

LCS - Modified 03/06/2008
PDF File ID: 4970238
Report generated: 10/11/2016 16:13

Microbac Laboratories Inc.

MS/MSD REPORT

Loginnum:L16091387 Cal ID:LCMS1- 03-MAY-16 Worknum:WG586928

Instrument ID:LCMS1 Contract #: Prep Method:6850

Parent ID:L16091387-01 File ID:1LM.LM37314 Dil:1 Method:6850

Sample ID:L16091387-02 MS File ID:1LM.LM37315 Dil:1 Matrix:Water

Sample ID:L16091387-03 MSD File ID:1LM.LM37316 Dil:1 Units:ug/L

Analyte	Parent	MS Spiked	MS Found	MS %Rec	MSD Spiked	MSD Found	MSD %Rec	%RPD	%Rec Limits	RPD Limit	Q
Perchlorate	U	0.200	0.213	107	0.200	0.207	104	2.86	80 - 120	15	

* FAILS %REC LIMIT

FAILS RPD LIMIT

MS_MSD - Modified 03/06/2008

PDF File ID: 4970239

Report generated 10/11/2016 16:13

Microbac Laboratories Inc.
INITIAL CALIBRATION SUMMARY

Login Number: L16091387
Analytical Method: 6850
ICAL Workgroup: WG567320

Instrument ID: LCMS1
Initial Calibration Date: 03-MAY-16 17:18
Column ID: F

Analyte		AVG RF	% RSD	LINEAR (R)	QUAD (R^2)
Perchlorate		1.699	4.81	1.00000	

R = Correlation coefficient; 0.995 minimum
R^2 = Coefficient of determination; 0.99 minimum

INT_CAL - Modified 03/06/2008
PDF File ID: 4970691
Report generated 10/11/2016 16:13

Login Number: L16091387
Analytical Method: 6850
Instrument ID: LCMS1
Initial Calibration Date: 03-MAY-16 17:18
Column ID: F

Analyte	WG567320-02			WG567320-03			WG567320-04		
	CONC	RESP	RF	CONC	RESP	RF	CONC	RESP	RF
Perchlorate	0.100	17900.0000	1.792	0.200	34100.0000	1.718	0.500	82200.0000	1.637

INT_CAL - Modified 03/06/2008
PDF File ID: 4970691
Report generated 10/11/2016 16:13

Login Number: L16091387
Analytical Method: 6850
Instrument ID: LCMS1
Initial Calibration Date: 03-MAY-16 17:18
Column ID: F

Analyte	WG567320-05			WG567320-06			WG567320-07		
	CONC	RESP	RF	CONC	RESP	RF	CONC	RESP	RF
Perchlorate	1.00	168000.000	1.697	2.00	330000.000	1.672	5.00	810000.000	1.695

INT_CAL - Modified 03/06/2008
PDF File ID: 4970691
Report generated 10/11/2016 16:13

Login Number: L16091387
Analytical Method: 6850
Instrument ID: LCMS1
Initial Calibration Date: 03-MAY-16 17:18
Column ID: F

Analyte	WG567320-08		
	CONC	RESP	RF
Perchlorate	10.0	1530000.00	1.680

INT_CAL - Modified 03/06/2008
PDF File ID: 4970691
Report generated 10/11/2016 16:13

Microbac Laboratories Inc.
ALTERNATE SOURCE CALIBRATION REPORT

Login Number: L16091387 Run Date: 05/03/2016 Sample ID: WG567320-09
Instrument ID: LCMS1 Run Time: 17:37 Method: 6850
File ID: 1LM.LM34694 Analyst: JWR QC Key: DOD4
ICal Workgroup: WG567320 Cal ID: LCMS1 - 03-MAY-16

Analyte		Expected	Found	Units	RF	%D	UCL	Q
Perchlorate		1.00	0.985	ug/L	1.66	1.50	15	

* Exceeds %D Limit

ALT - Modified 09/06/2007
Version 1.5 PDF File ID: 4970692
Report generated 10/11/2016 16:13

Microbac Laboratories Inc.
CONTINUING CALIBRATION BLANK (CCB)

Login Number:	L16091387	Run Date:	10/10/2016	Sample ID:	WG586942-01
Instrument ID:	LCMS1	Run Time:	14:10	Method:	6850
File ID:	1LM.LM37298	Analyst:	JWR	Units:	ug/L
Workgroup (AAB#):	WG586928	Cal ID:	LCMS1 - 03-MAY-16		
Matrix:	WATER	QAPP:	DOD4		

Analytes	MDL	RDL	Concentration	Qualifier
Perchlorate	0.100	0.400	0.100	U

U = Result is less than MDL.
F = Result is between MDL and RL.
* = Result is above RL.

CCB - Modified 03/05/2008
PDF File ID: 4970242
Report generated 10/11/2016 16:13

Login Number: L16091387 Run Date: 10/10/2016 Sample ID: WG586942-04
Instrument ID: LCMS1 Run Time: 18:54 Method: 6850
File ID: 1LM.LM37313 Analyst: JWR Units: ug/L
Workgroup (AAB#): WG586928 Cal ID: LCMS1 - 03-MAY-16
Matrix: WATER QAPP: DOD4

Analytes	MDL	RDL	Concentration	Qualifier
Perchlorate	0.100	0.400	0.100	U

U = Result is less than MDL.
F = Result is between MDL and RL.
* = Result is above RL.

CCB - Modified 03/05/2008
PDF File ID: 4970242
Report generated 10/11/2016 16:13

Login Number: L16091387 Run Date: 10/10/2016 Sample ID: WG586942-06
Instrument ID: LCMS1 Run Time: 23:00 Method: 6850
File ID: 1LM.LM37326 Analyst: JWR Units: ug/L
Workgroup (AAB#): WG586928 Cal ID: LCMS1 - 03-MAY-16
Matrix: WATER QAPP: DOD4

Analytes	MDL	RDL	Concentration	Qualifier
Perchlorate	0.100	0.400	0.100	U

U = Result is less than MDL.
F = Result is between MDL and RL.
* = Result is above RL.

CCB - Modified 03/05/2008
PDF File ID: 4970242
Report generated 10/11/2016 16:13

Login Number: L16091387 Run Date: 10/10/2016 Sample ID: WG586942-02
Instrument ID: LCMS1 Run Time: 14:29 Method: 6850
File ID: 1LM.LM37299 Analyst: JWR QC Key: DOD4
Workgroup (AAB#): WG586928 Cal ID: LCMS1 - 03-MAY-16
Matrix: WATER

Analyte		Expected	Found	UNITS	RF	%D	UCL	Q
Perchlorate		1.00	0.972	ug/L	1.64	2.80	15	

* Exceeds %D Criteria

CCV - Modified 03/05/2008
PDF File ID: 4970241
Report generated 10/11/2016 16:13

Login Number: L16091387 Run Date: 10/10/2016 Sample ID: WG586942-03
Instrument ID: LCMS1 Run Time: 18:16 Method: 6850
File ID: 1LM.LM37311 Analyst: JWR QC Key: DOD4
Workgroup (AAB#): WG586928 Cal ID: LCMS1 - 03-MAY-16
Matrix: WATER

Analyte		Expected	Found	UNITS	RF	%D	UCL	Q
Perchlorate		1.00	0.970	ug/L	1.64	3.00	15	

* Exceeds %D Criteria

CCV - Modified 03/05/2008
PDF File ID: 4970241
Report generated 10/11/2016 16:13

Login Number: L16091387 Run Date: 10/10/2016 Sample ID: WG586942-05
Instrument ID: LCMS1 Run Time: 22:22 Method: 6850
File ID: 1LM.LM37324 Analyst: JWR QC Key: DOD4
Workgroup (AAB#): WG586928 Cal ID: LCMS1 - 03-MAY-16
Matrix: WATER

Analyte		Expected	Found	UNITS	RF	%D	UCL	Q
Perchlorate		1.00	0.969	ug/L	1.64	3.10	15	

* Exceeds %D Criteria

CCV - Modified 03/05/2008
PDF File ID: 4970241
Report generated 10/11/2016 16:13

Login Number: L16091387 Run Date: 10/10/2016 Sample ID: WG586928-10
Instrument ID: LCMS1 Run Time: 14:48 Prep Method: 6850
File ID: 1LM.LM37300 Analyst: JWR Method: 6850
Workgroup (AAB#): WG586928 Matrix: Water Units: ug/L
Contract #: Cal ID: LCMS1-03-MAY-16

Analytes	Expected	Found	% Rec	Limits	Q
Perchlorate	0.200	0.205	103	70 - 130	

QCMRL - Modified 03/06/2007
PDF File ID: 4970240
Report generated 10/11/2016 16:13

Login Number: L16091387 Run Date: 10/10/2016 Sample ID: WG586928-11
Instrument ID: LCMS1 Run Time: 18:35 Prep Method: 6850
File ID: 1LM.LM37312 Analyst: JWR Method: 6850
Workgroup (AAB#): WG586928 Matrix: Water Units: ug/L
Contract #: Cal ID: LCMS1-03-MAY-16

Analytes	Expected	Found	% Rec	Limits	Q
Perchlorate	0.200	0.207	104	70 - 130	

QCMRL - Modified 03/06/2007
PDF File ID: 4970240
Report generated 10/11/2016 16:13

Login Number: L16091387 Run Date: 10/10/2016 Sample ID: WG586928-12
Instrument ID: LCMS1 Run Time: 22:41 Prep Method: 6850
File ID: 1LM.LM37325 Analyst: JWR Method: 6850
Workgroup (AAB#): WG586928 Matrix: Water Units: ug/L
Contract #: Cal ID: LCMS1-03-MAY-16

Analytes	Expected	Found	% Rec	Limits	Q
Perchlorate	0.200	0.210	105	70 - 130	

QCMRL - Modified 03/06/2007
PDF File ID: 4970240
Report generated 10/11/2016 16:13

Microbac Laboratories Inc.
INTERNAL STANDARD AREA SUMMARY
(COMPARED TO AVERAGE OF ICAL)

Login Number:L16091387
Instrument ID:LCMS1
Workgroup (AAB#):WG586928

ICAL CCV Number:WG567320-05
CAL ID: LCMS1-03-MAY-16
Matrix:WATER

Sample Number	Dilution	Tag	IS-1
WG567320	NA	NA	489000
Upper Limit	NA	NA	733500
Lower Limit	NA	NA	244500
L16091387-01	1.00	01	395000
L16091387-02	1.00	01	392000
L16091387-03	1.00	01	402000
L16091387-04	1.00	01	411000
L16091387-05	1.00	01	436000
L16091387-06	1.00	01	526000
L16091387-07	1.00	01	426000
L16091387-08	1.00	01	526000
L16091387-09	1.00	01	502000
WG586928-02	1.00	01	442000
WG586928-03	1.00	01	443000

IS-1 - O18LP

Underline = Response outside limits

INTERNAL_STD_AVG_ICAL - Modified 03/10/2010
PDF File ID: 4970243
Report generated 10/11/2016 16:13

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-01
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37314
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 19:13	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	4550	1810	2.51	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Microbac

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-02
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37315
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 19:32	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	28600	10600	2.70	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-03
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37316
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 19:51	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	28500	10500	2.71	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-04
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37317
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 20:10	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	7720	3370	2.29	2.3	3.8	*

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Microbac

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-05
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37318
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 20:29	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	3490	1660	2.10	2.3	3.8	*

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-06
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37319
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 20:48	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	4010	1550	2.59	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-07
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37320
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 21:07	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	0.000	0.000	0.000	2.3	3.8	*

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-08
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37321
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 21:26	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	125000	43900	2.85	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	L16091387-09
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37322
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 21:44	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	0.000	876	0.000	2.3	3.8	*

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG567320-02
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM34687
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	05/03/2016 15:25	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	17900	6950	2.58	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG567320-03
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM34688
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	05/03/2016 15:43	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	34100	11900	2.87	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG567320-04
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM34689
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	05/03/2016 16:02	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	82200	29400	2.80	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG567320-05
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM34690
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	05/03/2016 16:21	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	168000	56600	2.97	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG567320-06
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM34691
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	05/03/2016 16:40	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	330000	108000	3.06	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG567320-07
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM34692
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	05/03/2016 16:59	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	810000	269000	3.01	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Microbac

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG567320-08
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM34693
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	05/03/2016 17:18	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	1530000	512000	2.99	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG567320-09
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM34694
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	05/03/2016 17:37	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	169000	56300	3.00	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	WG586928-01
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37301
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 15:07	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	28200	8880	3.18	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	WG586928-02
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37302
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 15:26	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	0.000	0.000	0.000	2.3	3.8	*

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Microbac

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	WG586928-03
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37303
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 15:45	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	27900	10400	2.68	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	WG586928-10
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37300
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 14:48	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	30700	11100	2.77	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	WG586928-11
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37312
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 18:35	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	36200	12300	2.94	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Microbac

Login #:	L16091387	**Prep Method:**	6850	**Samplenum:**	WG586928-12
Instrument:	LCMS1	**Prep Date:**	10/10/2016 14:00	**File ID:**	1LM.LM37325
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 22:41	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	41100	14100	2.91	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG586942-01
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM37298
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 14:10	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	0.000	0.000	0.000	2.3	3.8	*

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG586942-02
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM37299
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 14:29	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	140000	48700	2.87	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG586942-03
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM37311
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 18:16	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	156000	54600	2.86	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG586942-04
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM37313
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 18:54	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	0.000	0.000	0.000	2.3	3.8	*

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG586942-05
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM37324
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 22:22	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	177000	60300	2.94	2.3	3.8	

Perchlorate Ion Ratios

Microbac Laboratories Inc.

Login #:	L16091387	**Prep Method:**		**Samplenum:**	WG586942-06
Instrument:	LCMS1	**Prep Date:**		**File ID:**	1LM.LM37326
Analyst:	JWR	**Anal Method:**	6850	**Matrix:**	Water
Worknum:	WG586928	**Analysis Date:**	10/10/2016 23:00	**Units:**	ug/L

Analyte	Res #1	Res #2	Ratio	Lower	Upper	Q
PERCHLORATE	0.000	0.000	0.000	2.3	3.8	*

2.1.1.3 Sample Data

Applied Biosystems | MDS SCIEX

Created with Analyst Reporter
Printed: 10/11/2016 11:43 AM

Data File	LM37314.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 7:13:24 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

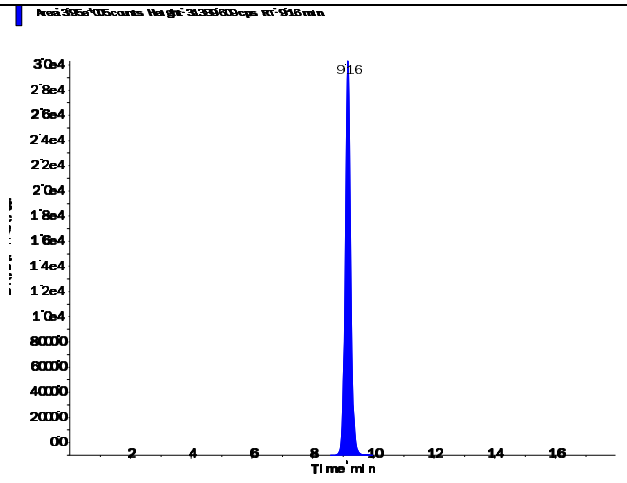
Sample Name	L16091387-01 RS	**Injection Vial**	14.00
Data File	LM37314.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 7:13:24 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-07	**Dilution Factor**	1.00
Sample Comment	1,1 (screened)	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	3.950e+05	9.16	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	4.550e+03	9.17	N/A	0.0305
Perchlorate conf	1.810e+03	9.17	N/A	0.0207

O18LP (Internal Standard)

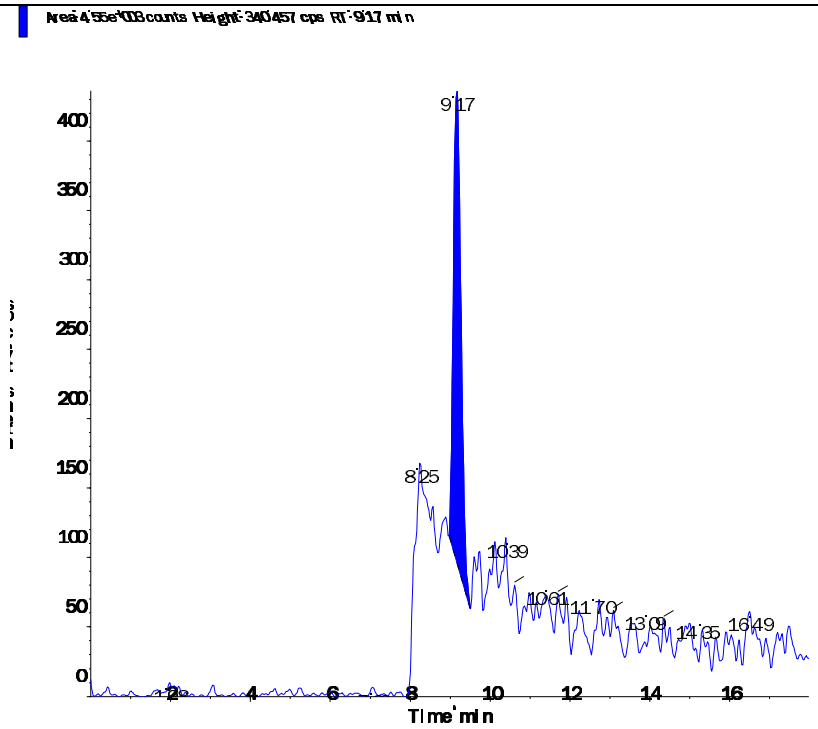
RT (Exp. RT): 9.16(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



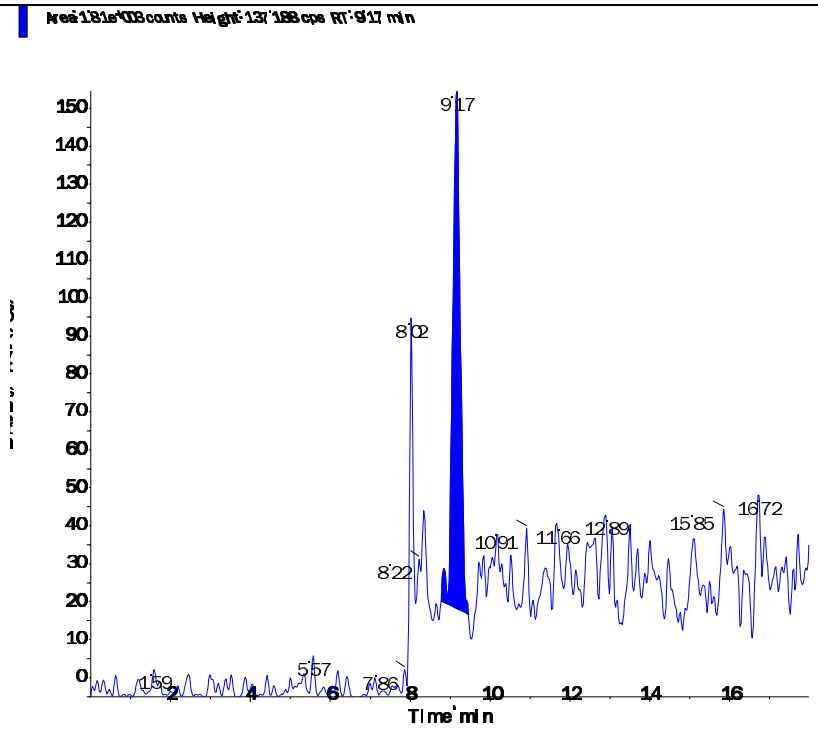
Applied Biosystems | MDS SCIEX

Created with Analyst Reporter
Printed: 10/11/2016 11:43 AM

Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.17 (9.84) min 0.0305 ng/ml 0.012 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.17 (9.84) min 0.0207 ng/ml 0.005 (Unknown)



Applied Biosystems | MDS SCIEX

Created with Analyst Reporter
Printed: 10/11/2016 11:44 AM

Data File	LM37315.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 7:32:20 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

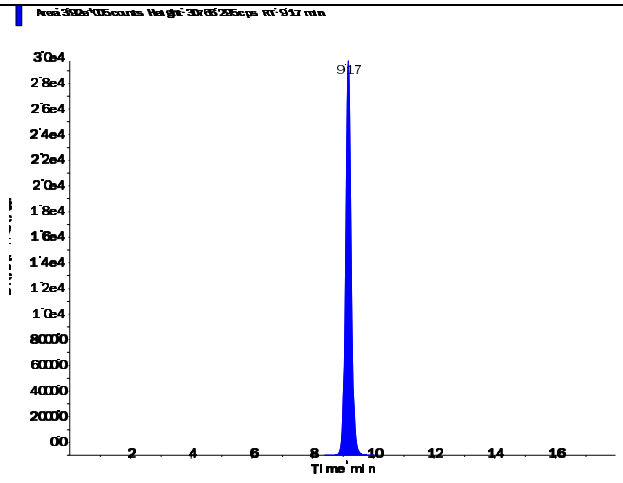
Sample Name	L16091387-02 MS	**Injection Vial**	15.00
Data File	LM37315.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 7:32:20 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-08	**Dilution Factor**	1.00
Sample Comment	1,1 STD78251	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	3.920e+05	9.17	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	2.860e+04	9.18	N/A	0.213
Perchlorate conf	1.060e+04	9.17	N/A	0.221

O18LP (Internal Standard)

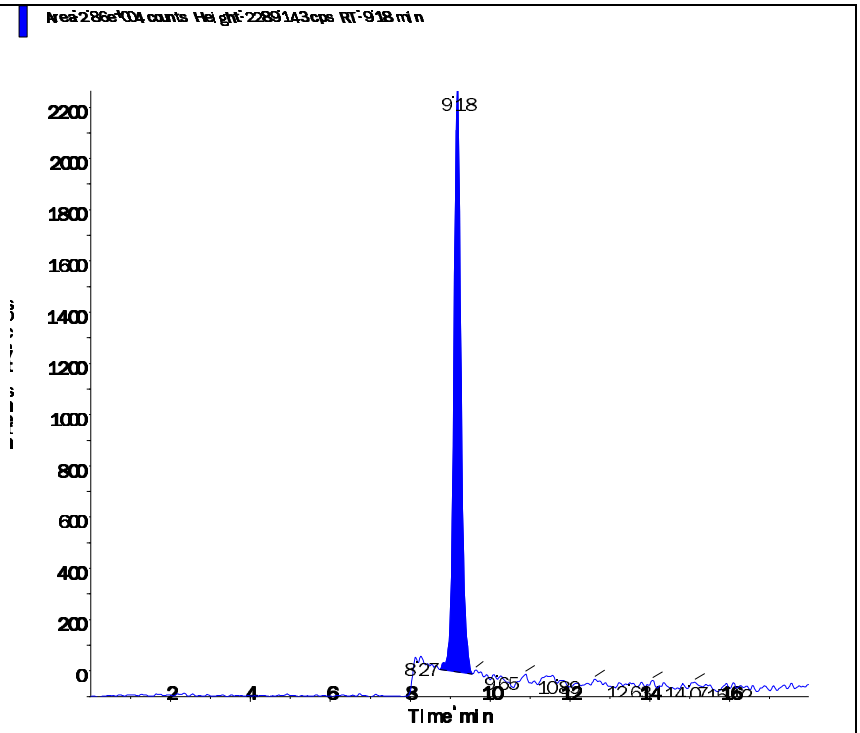
RT (Exp. RT): 9.17(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



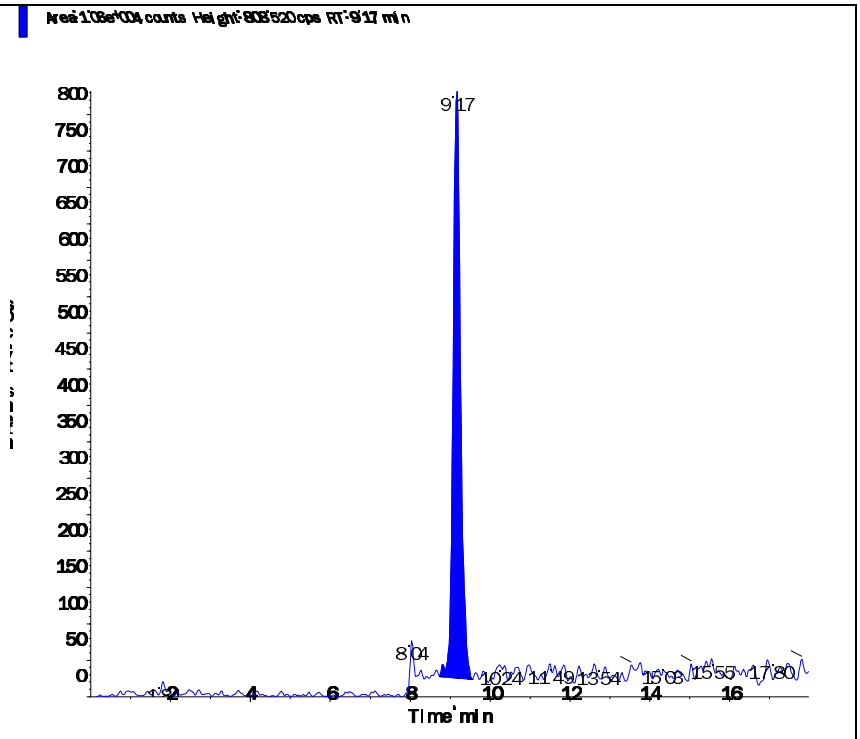
Applied Biosystems | MDS SCIEX

Created with Analyst Reporter
Printed: 10/11/2016 11:44 AM

Perchlorate (98.8/83.3 amu)	
RT (Exp. RT):	9.18 (9.84) min
Calculated conc:	0.213 ng/ml
Area Ratio:	0.073
Sample Type:	(Unknown)



Perchlorate conf (100.8/85.2 amu)	
RT (Exp. RT):	9.17 (9.84) min
Calculated conc:	0.221 ng/ml
Area Ratio:	0.027
Sample Type:	(Unknown)

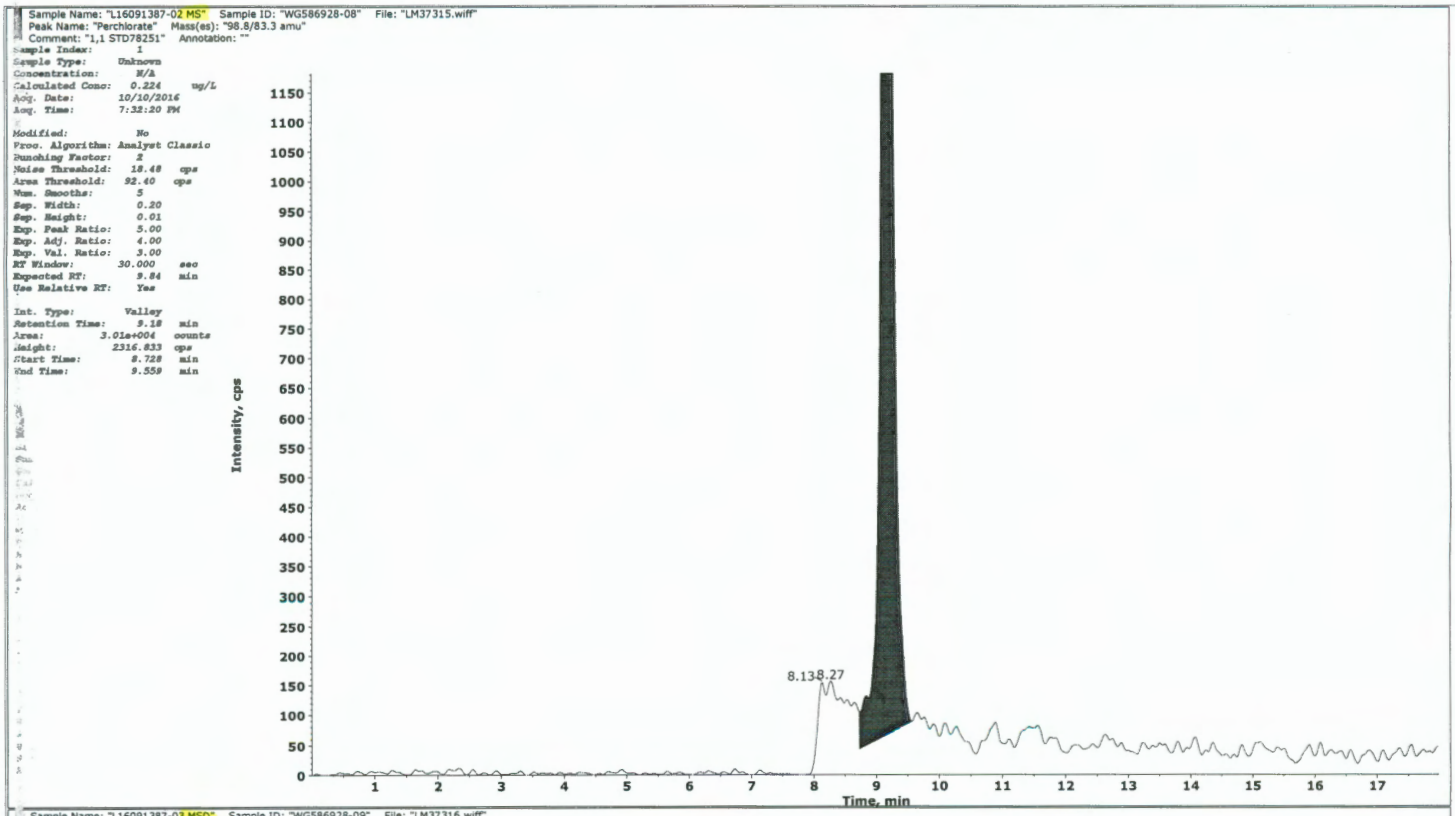


Sample Name: "L16091387-02 MS" Sample ID: "WG586928-08" File: "LM37315.wiff"
Peak Name: "Perchlorate" Mass(es): "98.8/83.3 amu"
Comment: "1,1 STD78251" Annotation: ""

Sample Index: 1
Sample Type: Unknown
Concentration: N/A
Calculated Conc: 0.224 ug/L
Acq. Date: 10/10/2016
Acq. Time: 7:32:20 PM

Modified: No
Proc. Algorithm: Analyst Classic
Punching Factor: 2
Noise Threshold: 18.48 cps
Area Threshold: 92.40 cps
Num. Smooths: 5
Sep. Width: 0.20
Sep. Height: 0.01
Exp. Peak Ratio: 5.00
Exp. Adj. Ratio: 4.00
Exp. Val. Ratio: 3.00
RT Window: 30.000 sec
Expected RT: 9.84 min
Use Relative RT: Yes

Int. Type: Valley
Retention Time: 9.18 min
Area: 3.01e+004 counts
Height: 2316.833 cps
Start Time: 8.728 min
End Time: 9.559 min

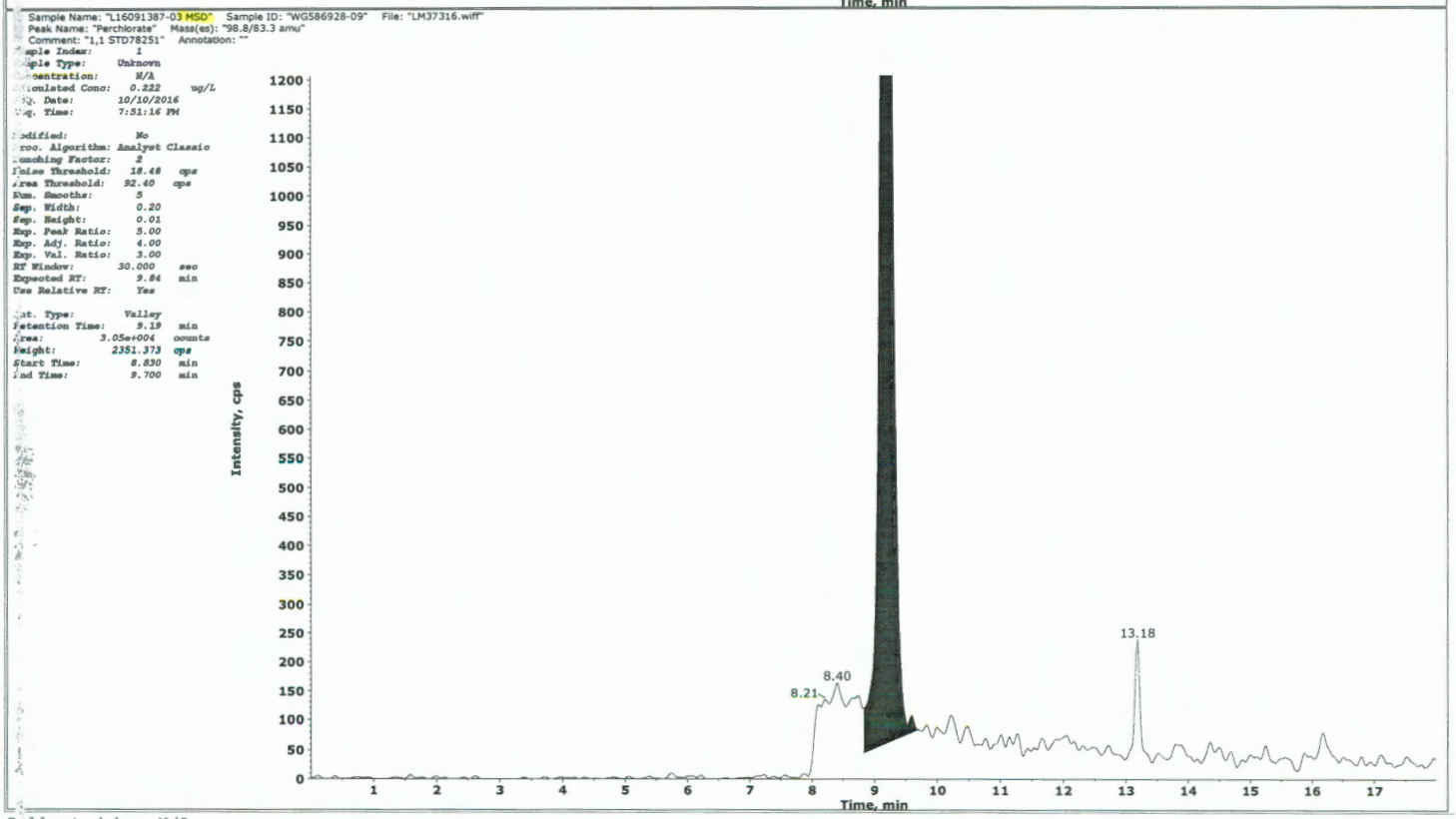


Sample Name: "L16091387-03 MSD" Sample ID: "WG586928-09" File: "LM37316.wiff"
Peak Name: "Perchlorate" Mass(es): "98.8/83.3 amu"
Comment: "1,1 STD78251" Annotation: ""

Sample Index: 1
Sample Type: Unknown
Concentration: N/A
Calculated Conc: 0.222 ug/L
Acq. Date: 10/10/2016
Acq. Time: 7:51:16 PM

Modified: No
Proc. Algorithm: Analyst Classic
Punching Factor: 2
Noise Threshold: 18.48 cps
Area Threshold: 92.40 cps
Num. Smooths: 5
Sep. Width: 0.20
Sep. Height: 0.01
Exp. Peak Ratio: 5.00
Exp. Adj. Ratio: 4.00
Exp. Val. Ratio: 3.00
RT Window: 30.000 sec
Expected RT: 9.84 min
Use Relative RT: Yes

Int. Type: Valley
Retention Time: 9.19 min
Area: 3.05e+004 counts
Height: 2351.373 cps
Start Time: 8.830 min
End Time: 9.700 min



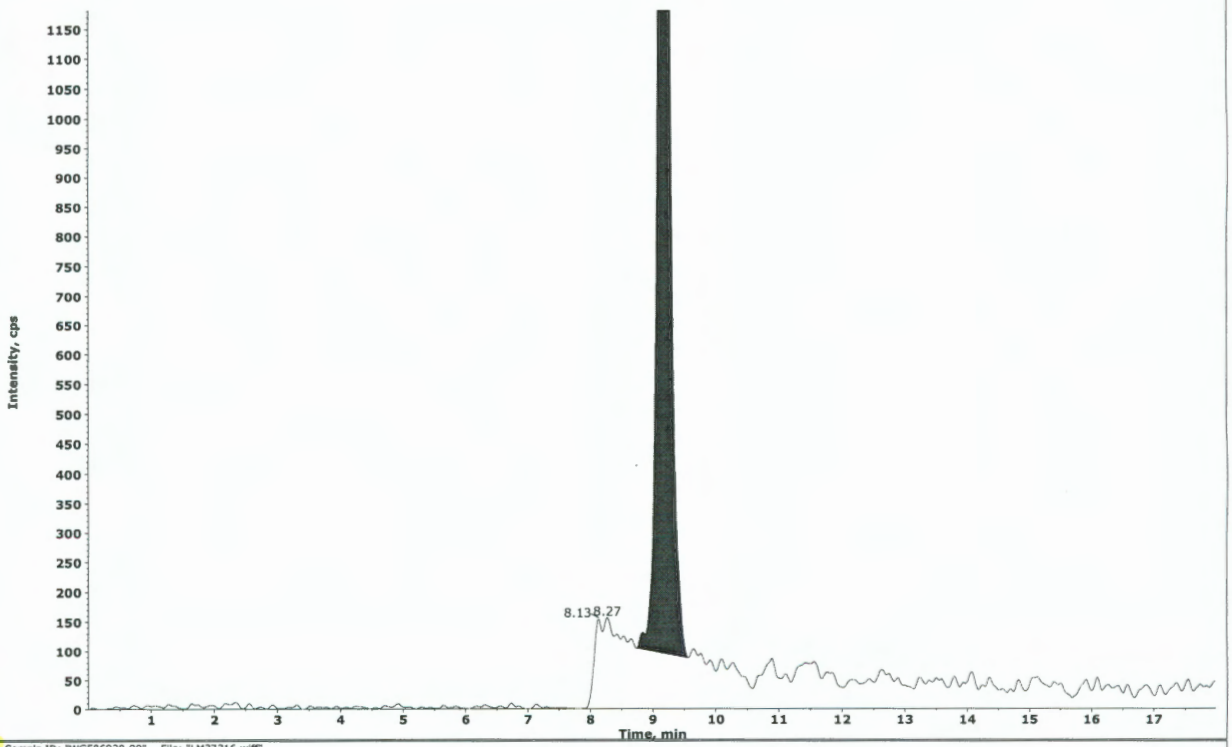
Collected by: N/A
Electronic Signature: no
Operator: lcms1

00915333

Sample Name: "L16091387-02 MS" Sample ID: "WG586928-08" File: "LM37315.wiff"
Peak Name: "Perchlorate" Mass(es): "98.8/83.3 amu"
Comment: "1,1 STD78251" Annotation: ""
Sample Index: 1
Sample Type: Unknown
Concentration: N/A
Calculated Conc: 0.213 ug/L
Acq. Date: 10/10/2016
Acq. Time: 7:32:20 PM

Modified: Yes
Proc. Algorithm: Analyst Classic
Smoothing Factor: 2
Noise Threshold: 18.48 cps
Area Threshold: 92.40 cps
Num. Smooths: 5
Sep. Width: 0.20
Sep. Height: 0.01
Exp. Peak Ratio: 5.00
Exp. Adj. Ratio: 4.00
Exp. Val. Ratio: 3.00
RT Window: 30.000 sec
Expected RT: 9.84 min
Use Relative RT: Yes

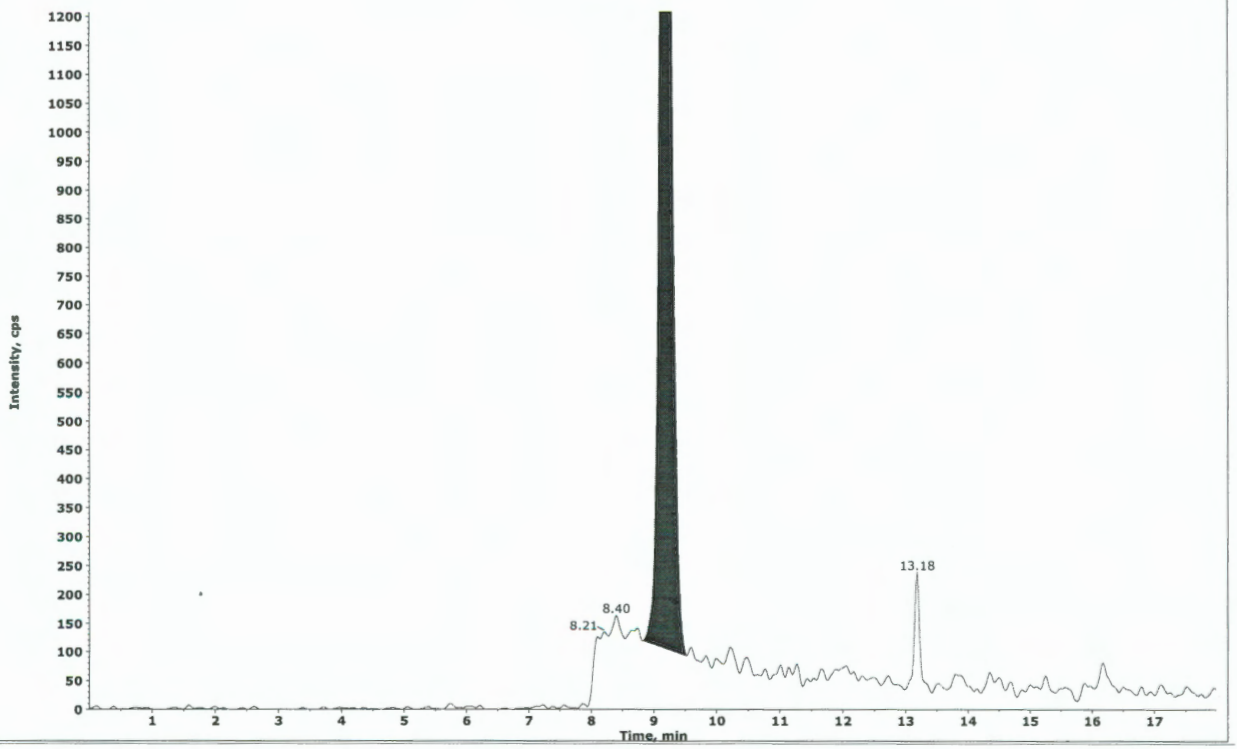
Int. Type: Manual
Retention Time: 9.18 min
Area: 2.86e+004 counts
Height: 2289.143 cps
Start Time: 8.749 min
End Time: 9.559 min



Sample Name: "L16091387-03 MSD" Sample ID: "WG586928-09" File: "LM37316.wiff"
Peak Name: "Perchlorate" Mass(es): "98.8/83.3 amu"
Comment: "1,1 STD78251" Annotation: ""
Sample Index: 1
Sample Type: Unknown
Concentration: N/A
Calculated Conc: 0.207 ug/L
Acq. Date: 10/10/2016
Acq. Time: 7:51:16 PM

Modified: Yes
Proc. Algorithm: Analyst Classic
Smoothing Factor: 2
Noise Threshold: 18.48 cps
Area Threshold: 92.40 cps
Num. Smooths: 5
Sep. Width: 0.20
Sep. Height: 0.01
Exp. Peak Ratio: 5.00
Exp. Adj. Ratio: 4.00
Exp. Val. Ratio: 3.00
RT Window: 30.000 sec
Expected RT: 9.84 min
Use Relative RT: Yes

Int. Type: Manual
Retention Time: 9.19 min
Area: 2.85e+004 counts
Height: 2308.280 cps
Start Time: 8.830 min
End Time: 9.518 min



Collected by: N/A
Electronic Signature: no
Operator: lcms1

#4
JWR/10/11/16
mg 10/11/16

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Printed: 10/11/2016 11:44 AM

Data File	LM37316.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 7:51:16 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

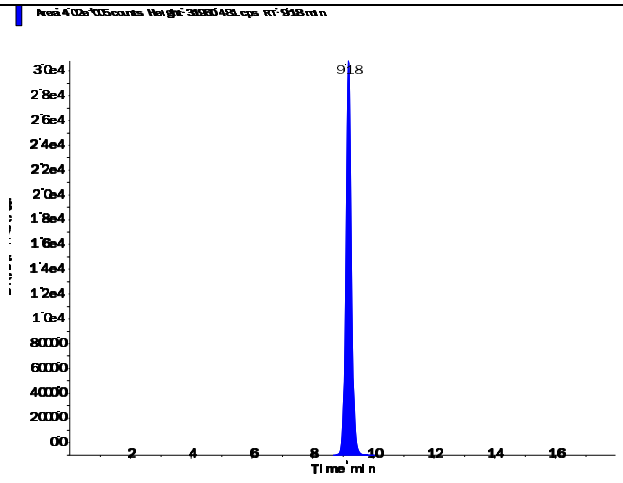
Sample Name	L16091387-03 MSD	**Injection Vial**	16.00
Data File	LM37316.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 7:51:16 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-09	**Dilution Factor**	1.00
Sample Comment	1,1 STD78251	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.020e+05	9.18	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	2.850e+04	9.19	N/A	0.207
Perchlorate conf	1.050e+04	9.18	N/A	0.214

O18LP (Internal Standard)

RT (Exp. RT): 9.18(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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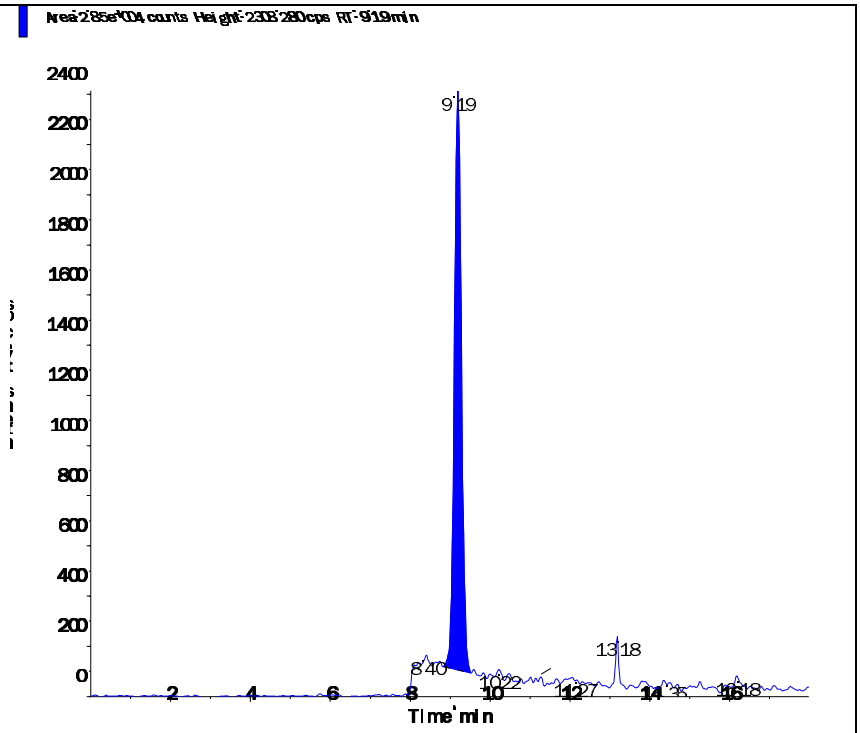
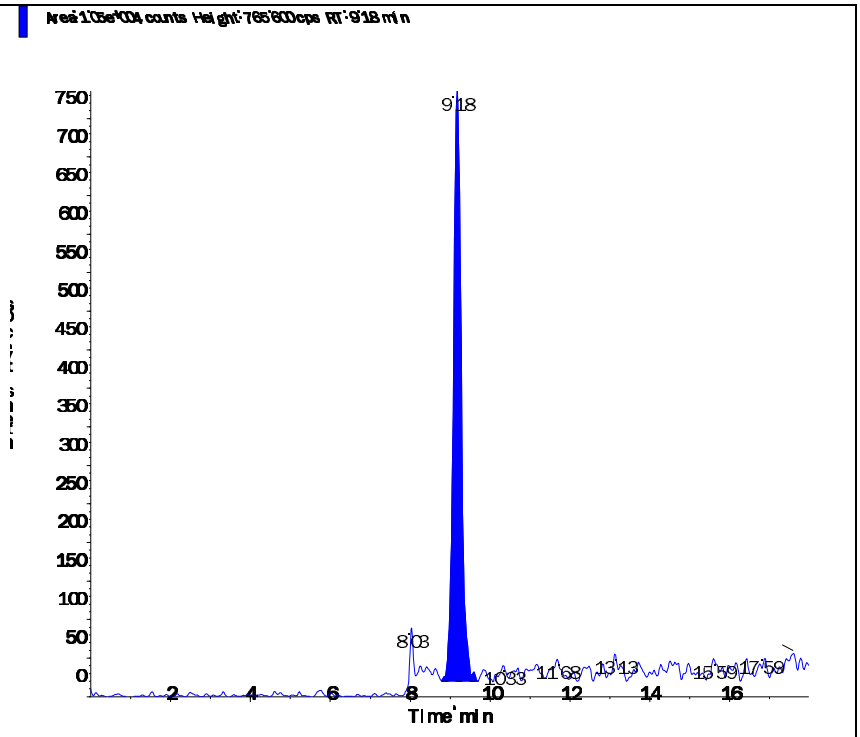
Printed: 10/11/2016 11:44 AM

Perchlorate (98.8/83.3 amu)	
RT (Exp. RT):	9.19 (9.84) min
Calculated conc:	0.207 ng/ml
Area Ratio:	0.071
Sample Type:	(Unknown)



Perchlorate conf (100.8/85.2 amu)	
RT (Exp. RT):	9.18 (9.84) min
Calculated conc:	0.214 ng/ml
Area Ratio:	0.026
Sample Type:	(Unknown)



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Printed: 10/11/2016 11:44 AM

Data File	LM37317.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 8:10:11 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

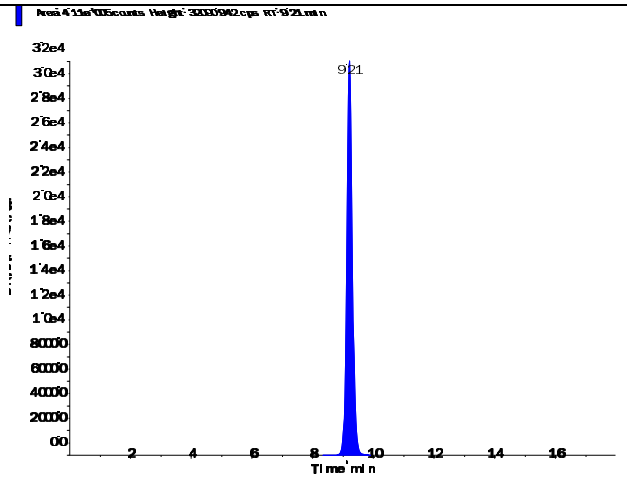
Sample Name	L16091387-04	**Injection Vial**	17.00
Data File	LM37317.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 8:10:11 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	L16091387-04	**Dilution Factor**	1.00
Sample Comment	1,1 (screened)	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.110e+05	9.21	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	7.720e+03	9.22	N/A	0.052
Perchlorate conf	3.370e+03	9.20	N/A	0.0531

O18LP (Internal Standard)

RT (Exp. RT): 9.21(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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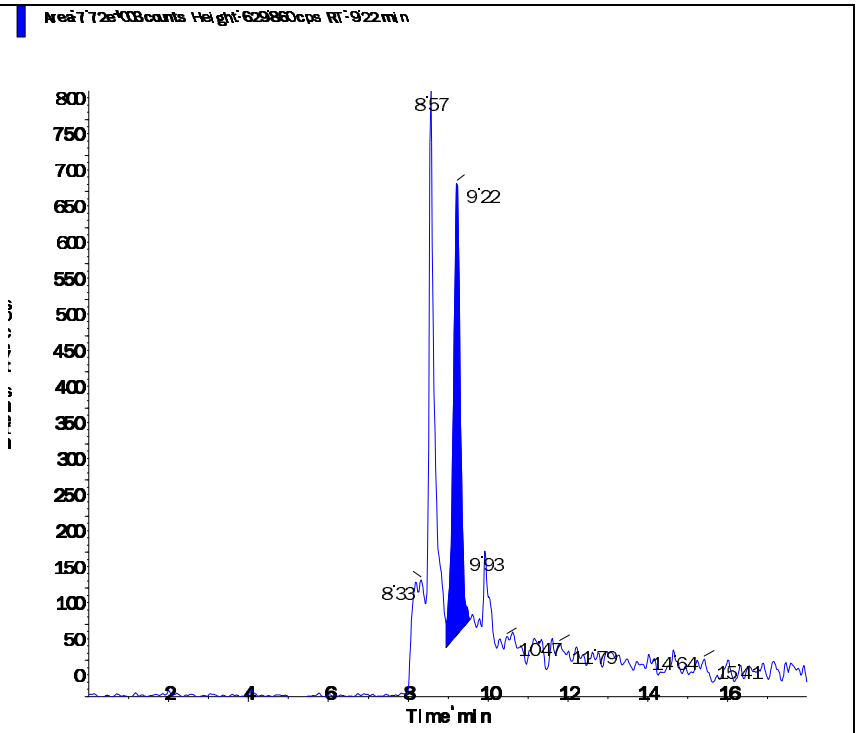
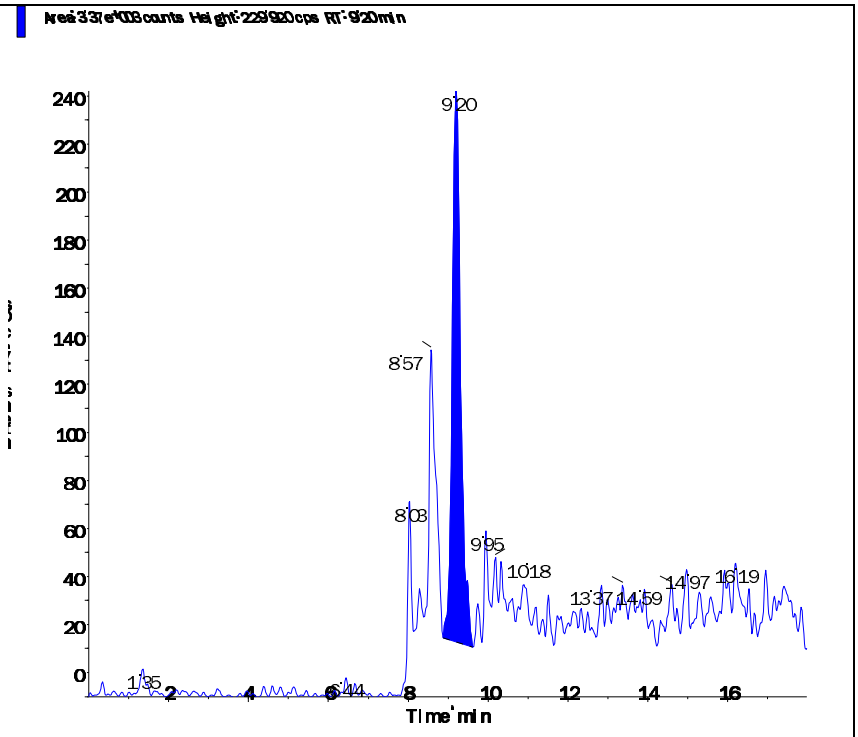
Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.22 (9.84) min 0.052 ng/ml 0.019 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.20 (9.84) min 0.0531 ng/ml 0.008 (Unknown)



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Data File	LM37318.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 8:29:10 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

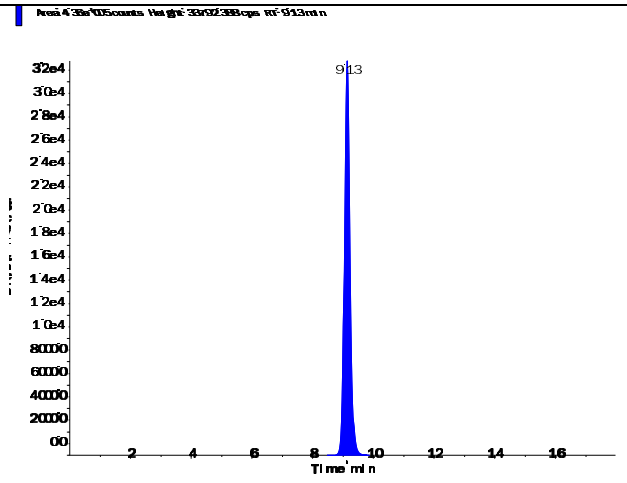
Sample Name	L16091387-05	**Injection Vial**	18.00
Data File	LM37318.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 8:29:10 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	L16091387-05	**Dilution Factor**	1.00
Sample Comment	1,1 (screened)	**Weight to Volume**	0.00

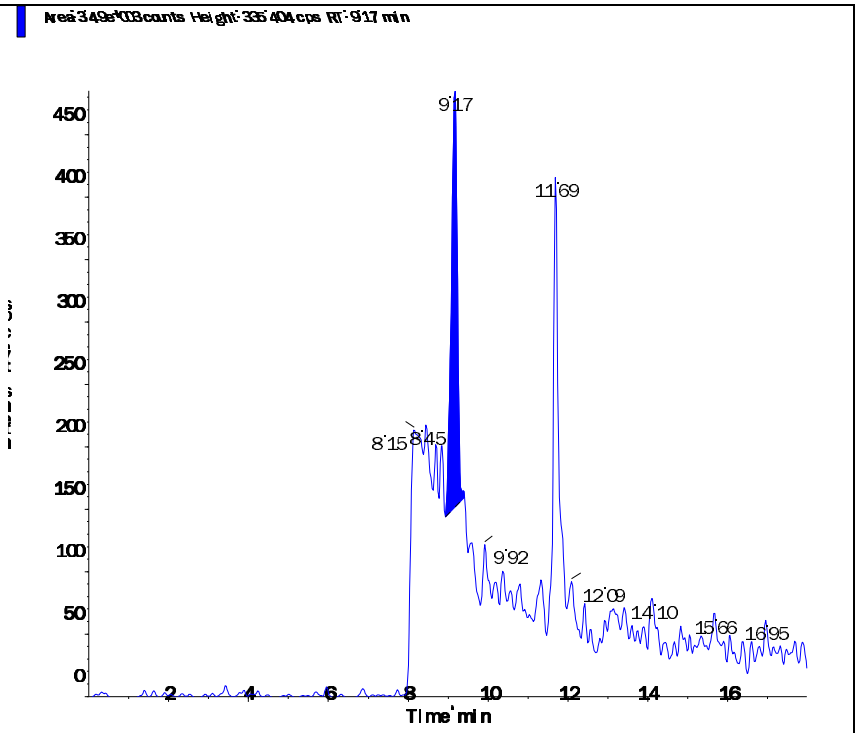
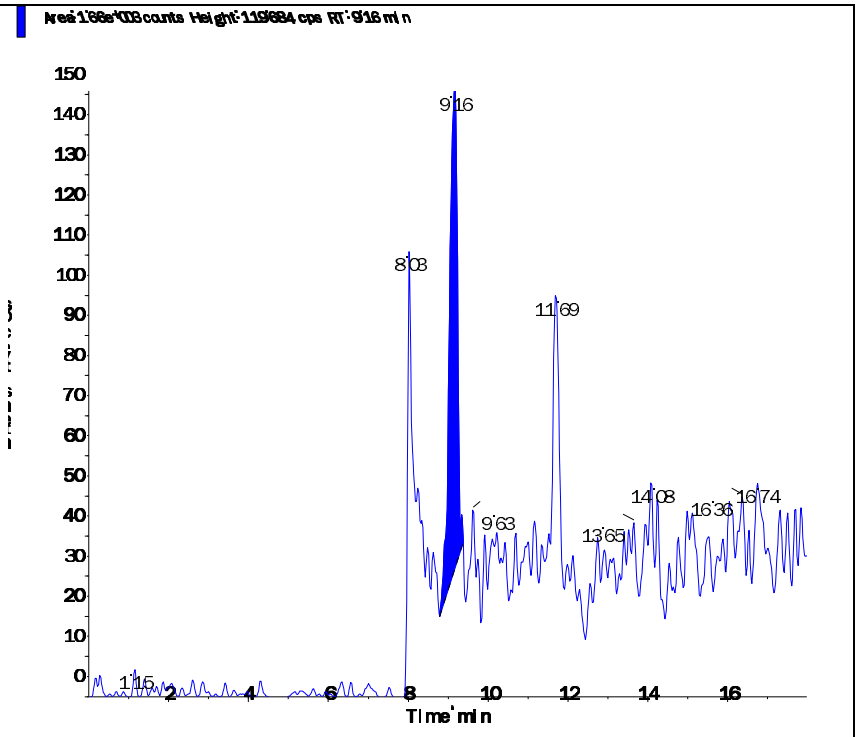
Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.360e+05	9.13	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	3.490e+03	9.17	N/A	0.02
Perchlorate conf	1.660e+03	9.16	N/A	0.0138

O18LP (Internal Standard)

RT (Exp. RT): 9.13(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



Perchlorate (98.8/83.3 amu) RT (Exp. RT): 9.17 (9.84) min Calculated conc: 0.02 ng/ml Area Ratio: 0.008 Sample Type: (Unknown)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 9.16 (9.84) min Calculated conc: 0.0138 ng/ml Area Ratio: 0.004 Sample Type: (Unknown)	

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Data File	LM37319.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 8:48:06 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

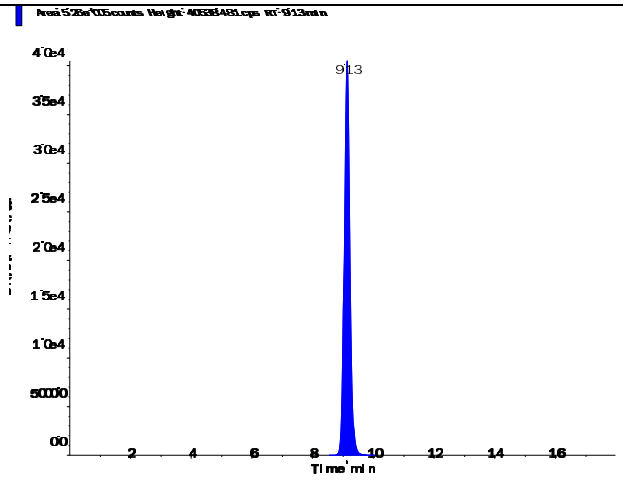
Sample Name	L16091387-06	**Injection Vial**	19.00
Data File	LM37319.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 8:48:06 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	L16091387-06	**Dilution Factor**	1.00
Sample Comment	1,1 (screened)	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.260e+05	9.13	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	4.010e+03	9.15	N/A	0.0189
Perchlorate conf	1.550e+03	9.14	N/A	0.006

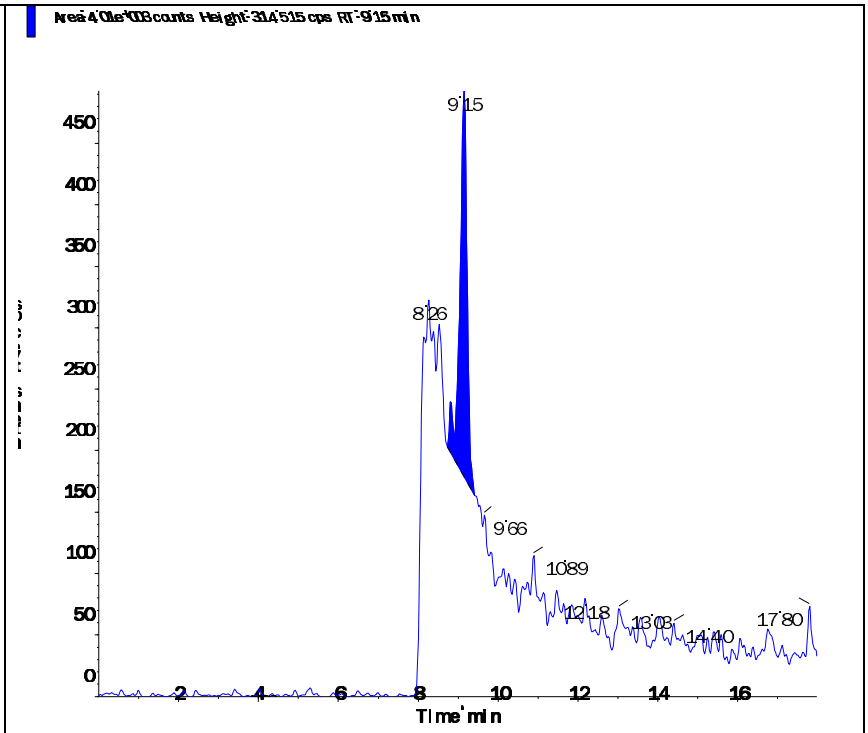
O18LP (Internal Standard)

RT (Exp. RT): 9.13(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



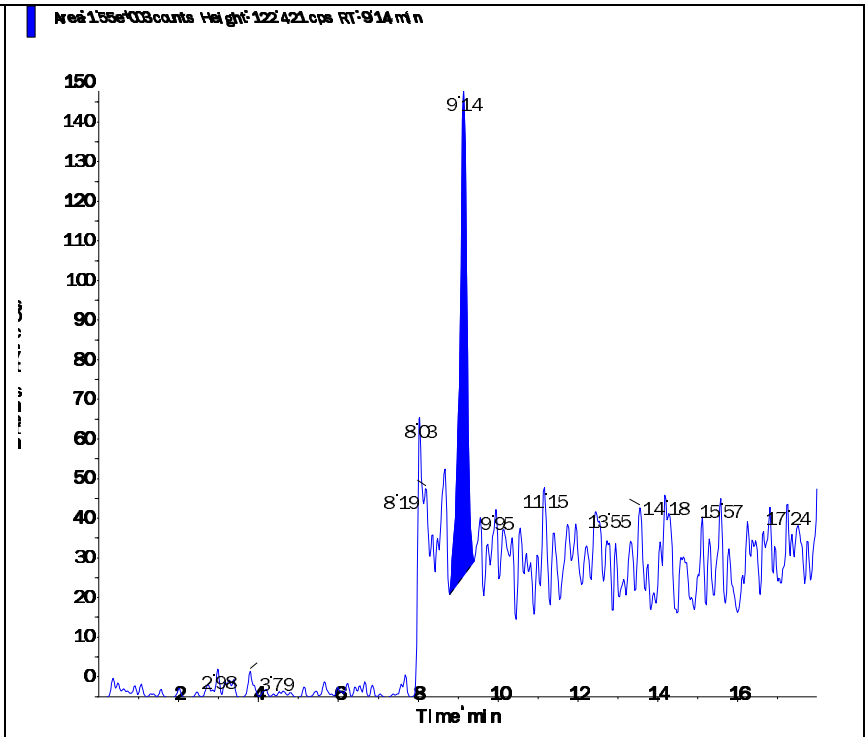
Perchlorate (98.8/83.3 amu)

RT (Exp. RT):	9.15 (9.84) min
Calculated conc:	0.0189 ng/ml
Area Ratio:	0.008
Sample Type:	(Unknown)



Perchlorate conf (100.8/85.2 amu)

RT (Exp. RT):	9.14 (9.84) min
Calculated conc:	0.006 ng/ml
Area Ratio:	0.003
Sample Type:	(Unknown)



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Data File	LM37320.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 9:07:05 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

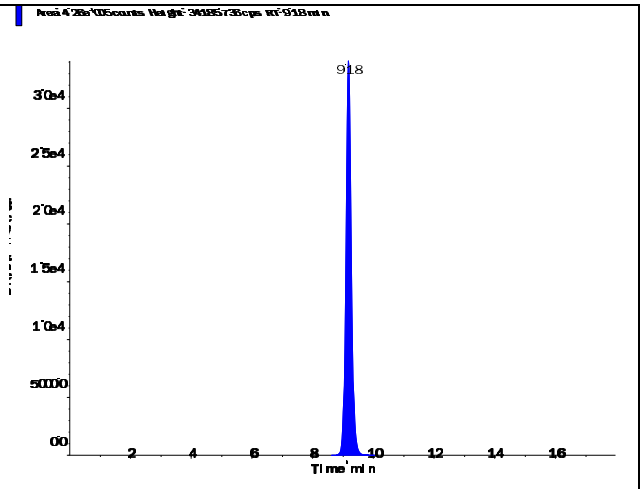
Sample Name	L16091387-07	**Injection Vial**	20.00
Data File	LM37320.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 9:07:05 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	L16091387-07	**Dilution Factor**	1.00
Sample Comment	1,1 (screened)	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.260e+05	9.18	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	0.000e+00	0.00	N/A	No Peak
Perchlorate conf	0.000e+00	0.00	N/A	No Peak

O18LP (Internal Standard)

RT (Exp. RT): 9.18(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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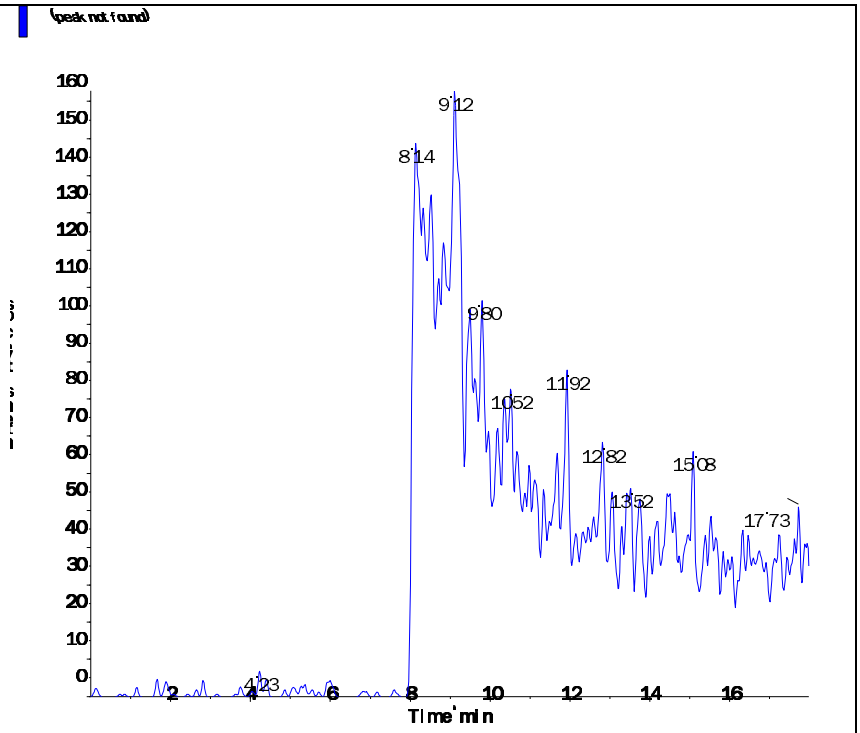
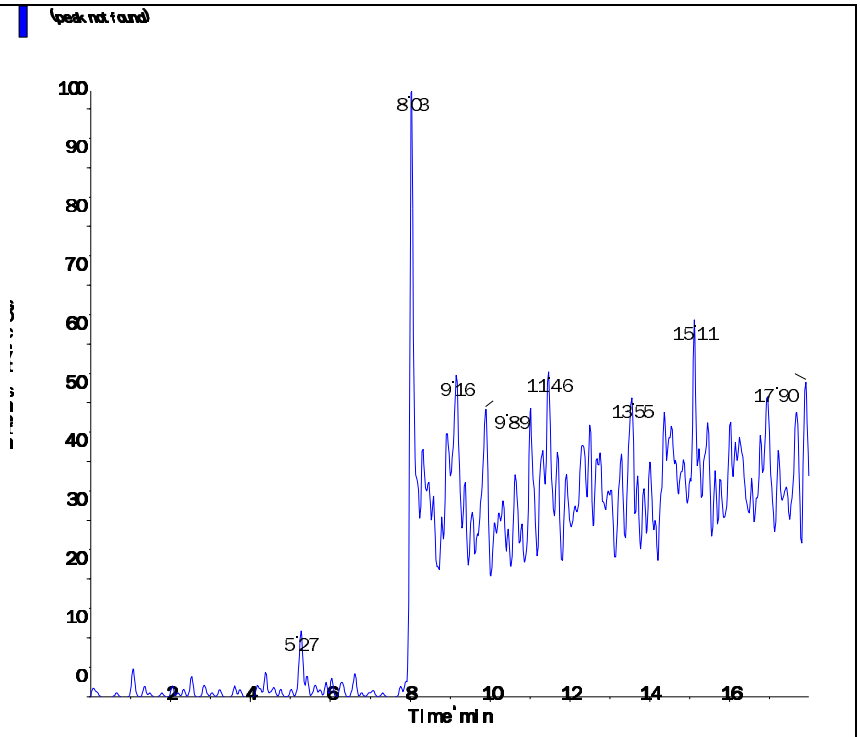
Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	0.00 (9.84) min No Peak ng/ml 0.00 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	0.00 (9.84) min No Peak ng/ml 0.00 (Unknown)



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Printed: 10/11/2016 11:45 AM

Data File	LM37321.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 9:26:00 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

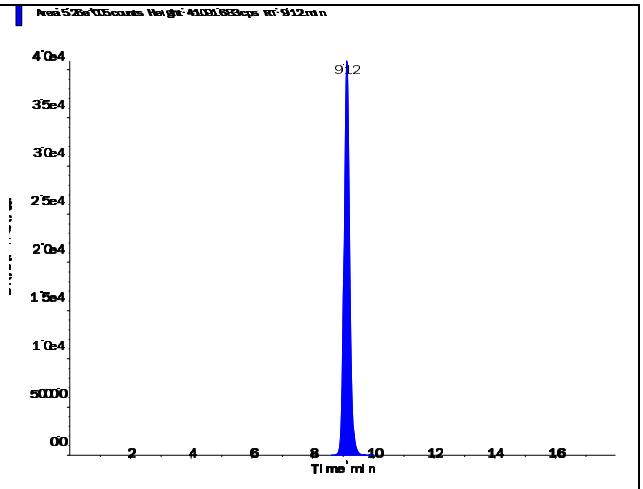
Sample Name	L16091387-08	**Injection Vial**	21.00
Data File	LM37321.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 9:26:00 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	L16091387-08	**Dilution Factor**	1.00
Sample Comment	1,1 (screened)	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.260e+05	9.12	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	1.250e+05	9.13	N/A	0.705
Perchlorate conf	4.390e+04	9.12	N/A	0.728

O18LP (Internal Standard)

RT (Exp. RT): 9.12(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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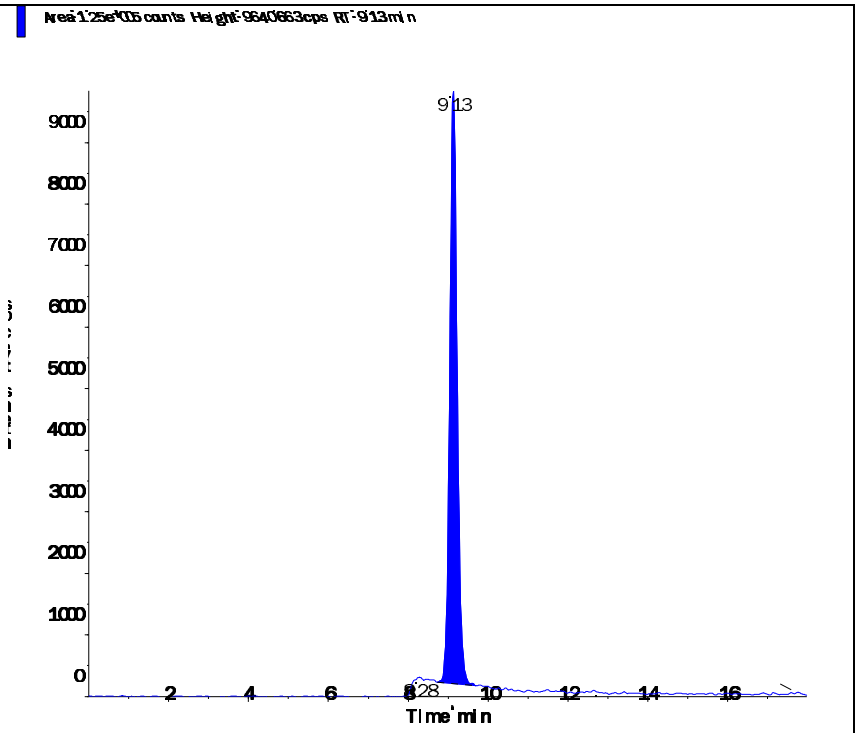
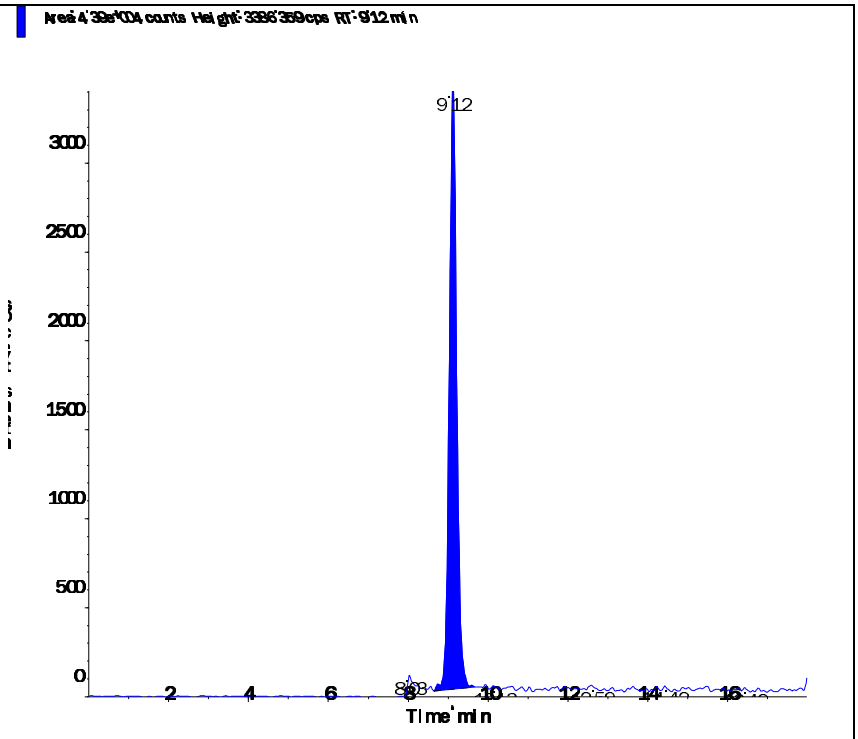
Printed: 10/11/2016 11:45 AM

Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.13 (9.84) min 0.705 ng/ml 0.238 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.12 (9.84) min 0.728 ng/ml 0.084 (Unknown)



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Printed: 10/11/2016 11:46 AM

Data File	LM37322.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 9:44:56 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

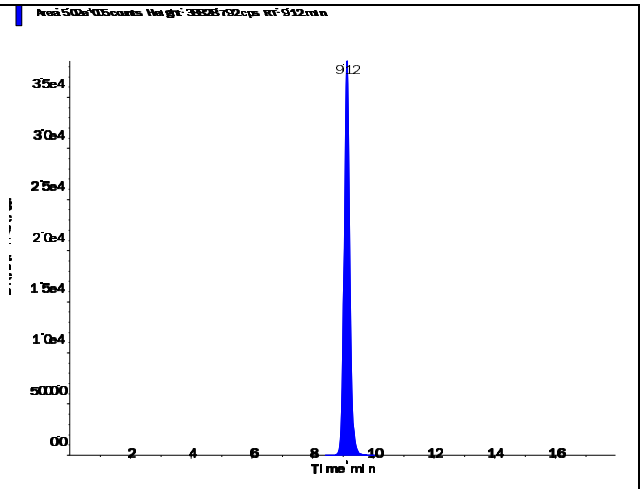
Sample Name	L16091387-09	**Injection Vial**	22.00
Data File	LM37322.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 9:44:56 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	L16091387-09	**Dilution Factor**	1.00
Sample Comment	1,1 (screened)	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.020e+05	9.12	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	0.000e+00	0.00	N/A	No Peak
Perchlorate conf	8.760e+02	9.09	N/A	< 0

O18LP (Internal Standard)

RT (Exp. RT): 9.12(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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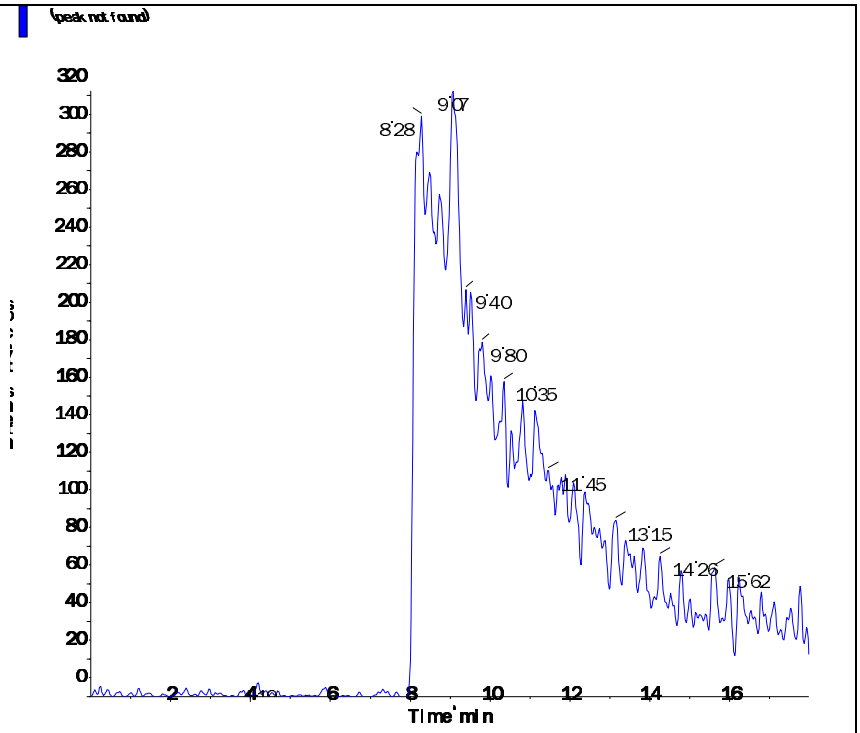
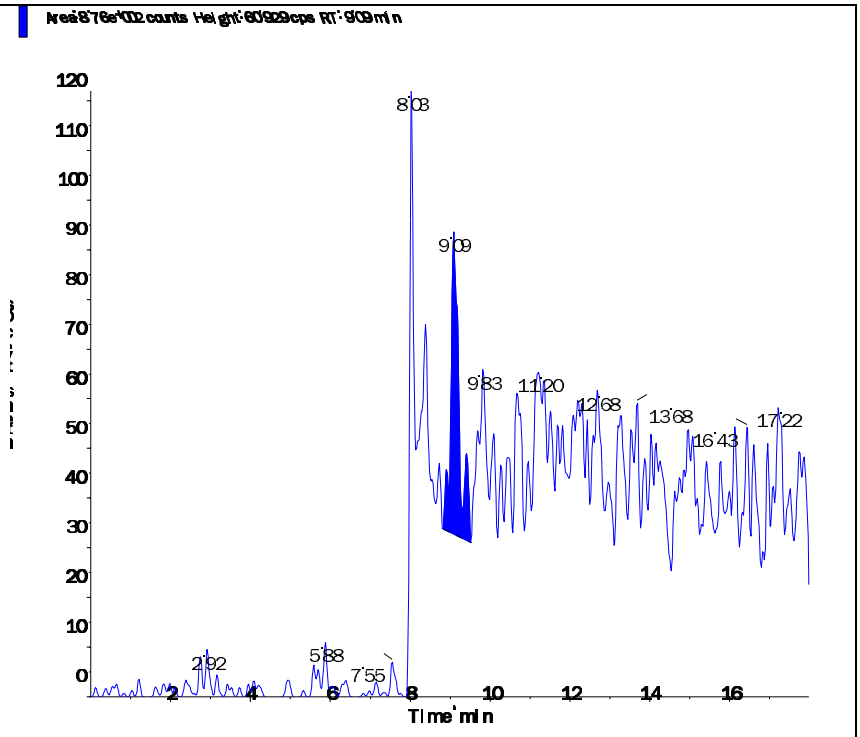
Perchlorate (98.8/83.3 amu)	
RT (Exp. RT):	0.00 (9.84) min
Calculated conc:	No Peak ng/ml
Area Ratio:	0.00
Sample Type:	(Unknown)



Perchlorate conf (100.8/85.2 amu)	
RT (Exp. RT):	9.09 (9.84) min
Calculated conc:	< 0 ng/ml
Area Ratio:	0.002
Sample Type:	(Unknown)



2.1.1.4 Standards Data

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Data File	LM34686.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	5/3/2016 3:06:05 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

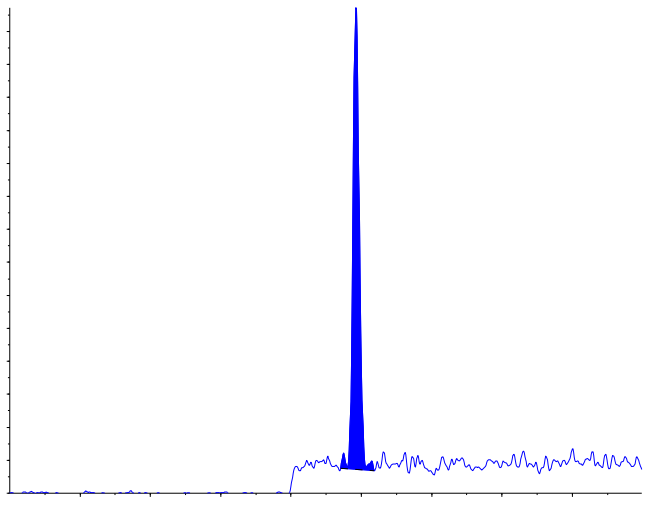
Sample Name	WG567320-01 CCB	**Injection Vial**	1.00
Data File	LM34686.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 3:06:05 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG567320-01	**Dilution Factor**	1.00
Sample Comment	11.00	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.020e+05	9.84	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	0.000e+00	0.00	N/A	No Peak
Perchlorate conf	0.000e+00	0.00	N/A	No Peak

O18LP (Internal Standard)

RT (Exp. RT): 9.84(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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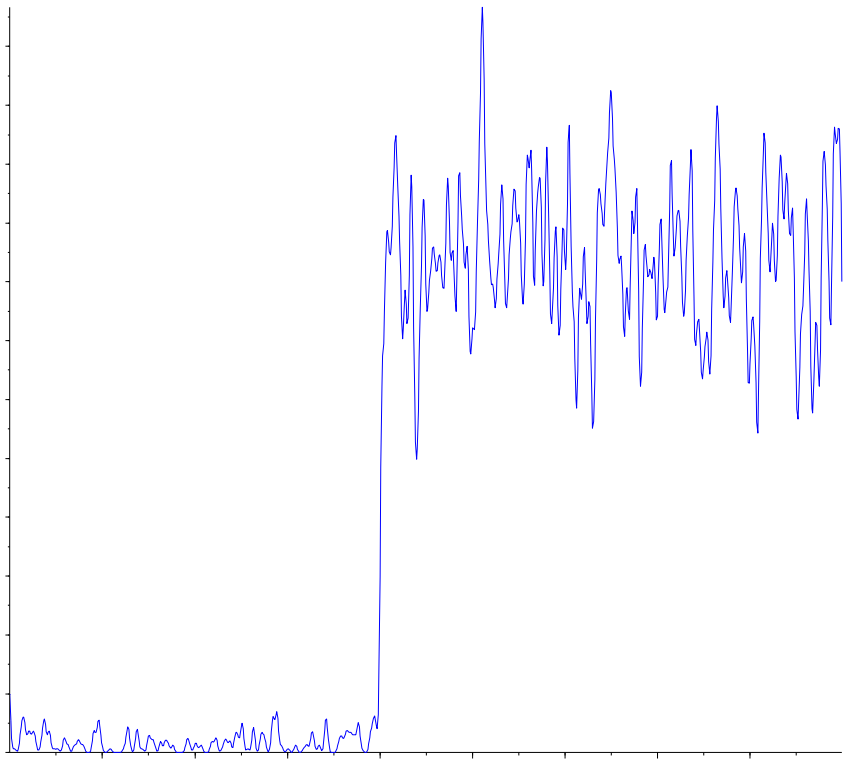
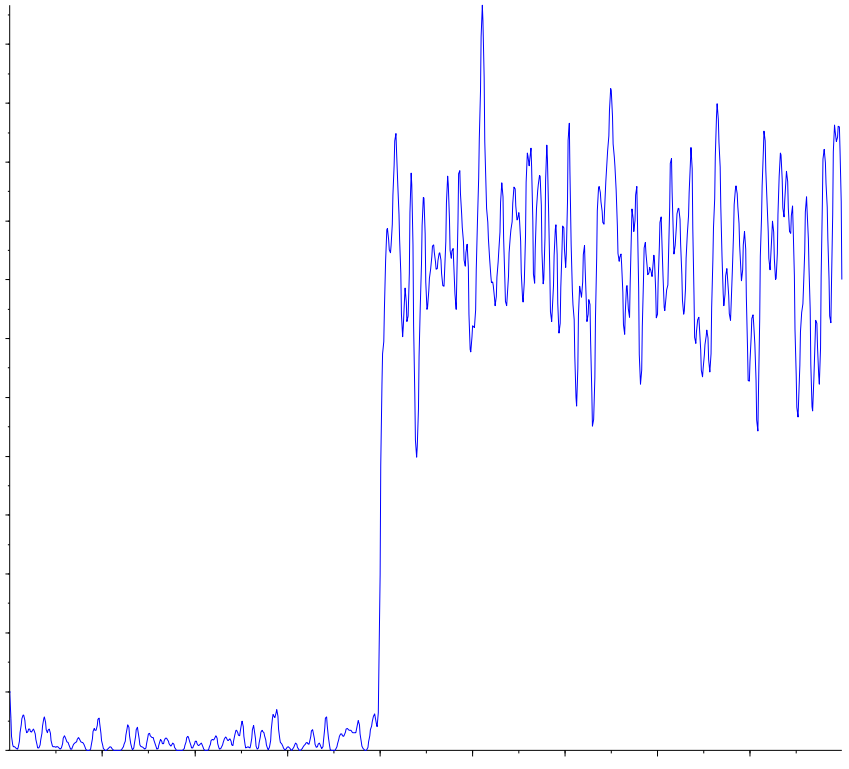
Perchlorate (98.8/83.3 amu)

RT (Exp. RT):	0.00 (9.84) min
Calculated conc:	No Peak ng/ml
Area Ratio:	0.00
Sample Type:	(Unknown)



Perchlorate conf (100.8/85.2 amu)

RT (Exp. RT):	0.00 (9.84) min
Calculated conc:	No Peak ng/ml
Area Ratio:	0.00
Sample Type:	(Unknown)



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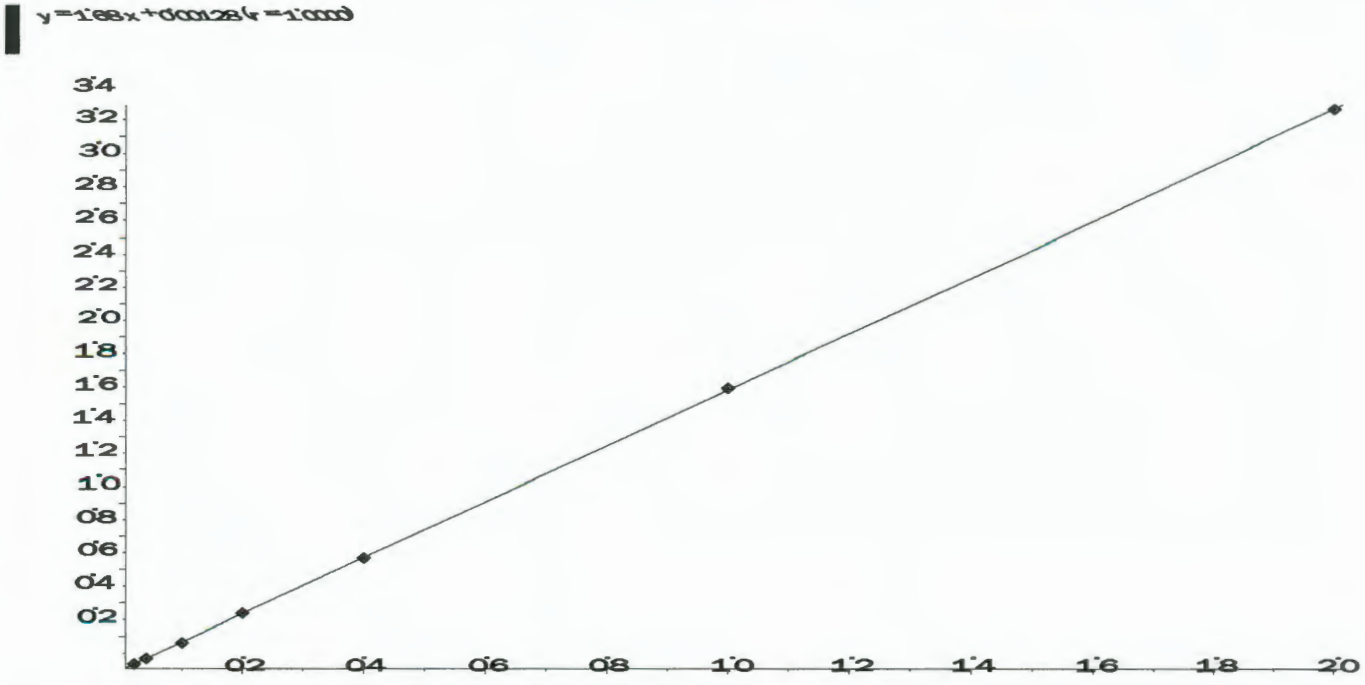
Printed: 5/4/2016 1:20 PM

Analyte Name: **Perchlorate**
Internal Standard: O18LP

Data File	LM34686.wiff	**Result Table**	050316_JWR.rdb
Acquisition Date	5/3/2016 3:06:05 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

Regression Equation: y = 1.68 x + 0.00128 (r = 1.0000)

Expected Concentration	Number of Values	Mean Calculated Concentration	% Accuracy	Std. Deviation	%CV
0.10	1	0.10	102.8	N/A	N/A
0.20	1	0.20	100.3	N/A	N/A
0.50	1	0.48	96.6	N/A	N/A
1.00	1	1.01	100.5	N/A	N/A
2.00	1	1.99	99.3	N/A	N/A
5.00	1	5.04	100.7	N/A	N/A
10.00	1	9.99	99.9	N/A	N/A



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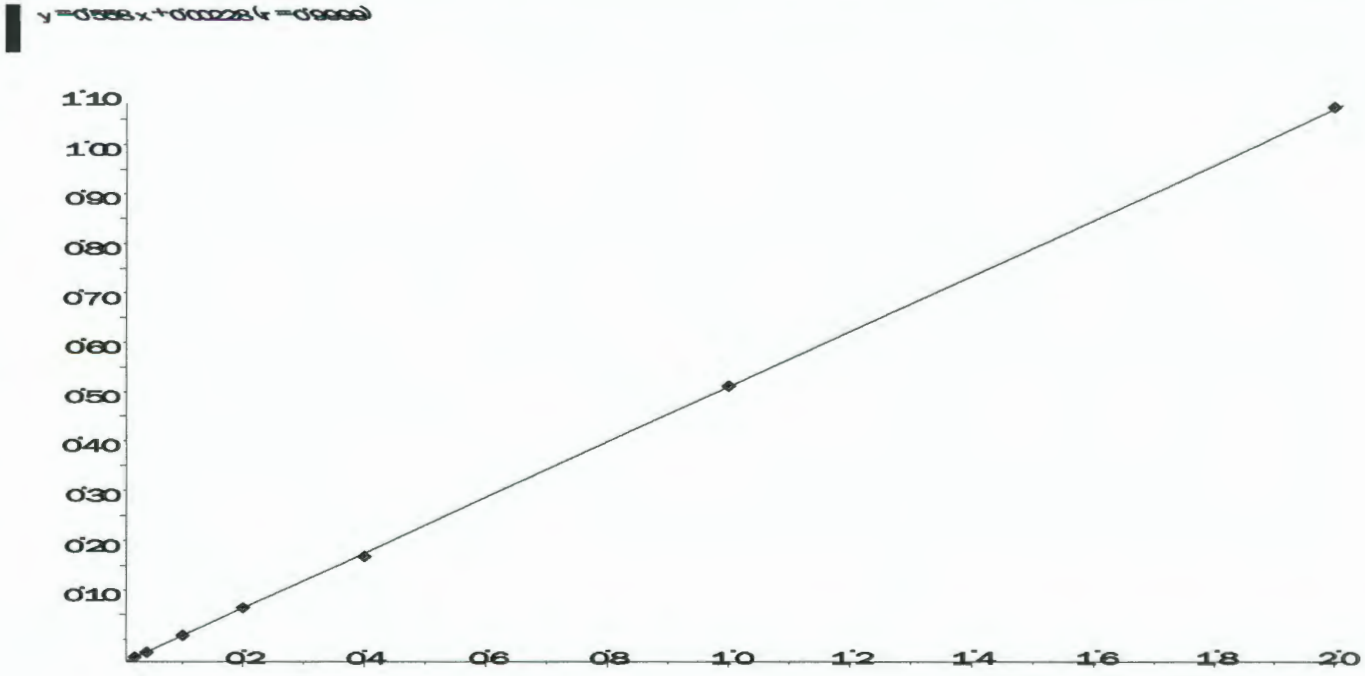
Printed: 5/4/2016 1:20 PM

Analyte Name: **Perchlorate conf**
Internal Standard: O18LP

Data File	LM34686.wiff	**Result Table**	050316_JWR.rdb
Acquisition Date	5/3/2016 3:06:05 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

Regression Equation: y = 0.558 x + 0.00228 (r = 0.9999)

Expected Concentration	Number of Values	Mean Calculated Concentration	% Accuracy	Std. Deviation	%CV
0.10	1	0.10	104.3	N/A	N/A
0.20	1	0.19	96.8	N/A	N/A
0.50	1	0.50	100.6	N/A	N/A
1.00	1	1.00	100.5	N/A	N/A
2.00	1	1.94	97.2	N/A	N/A
5.00	1	5.02	100.4	N/A	N/A
10.00	1	10.03	100.3	N/A	N/A



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Data File	LM34687.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	5/3/2016 3:25:04 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

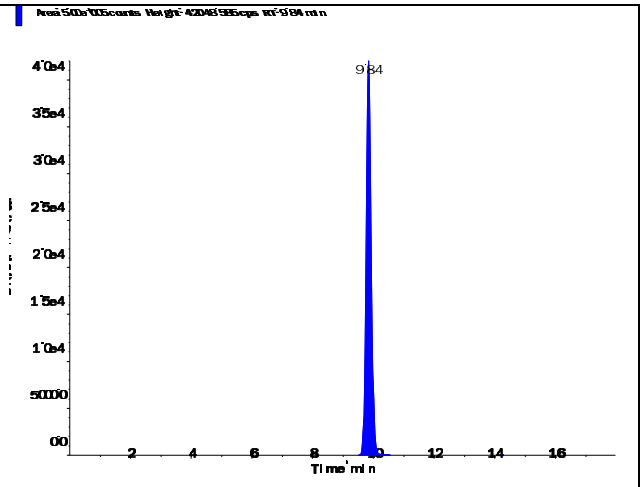
Sample Name	WG567320-02 STD (0.1 ug/L)	**Injection Vial**	2.00
Data File	LM34687.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 3:25:04 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Standard
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG567320-02	**Dilution Factor**	1.00
Sample Comment	1,1 STD75510	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.000e+05	9.84	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	1.790e+04	9.85	0.10	0.103
Perchlorate conf	6.950e+03	9.83	0.10	0.104

O18LP (Internal Standard)

RT (Exp. RT): 9.84(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Standard)



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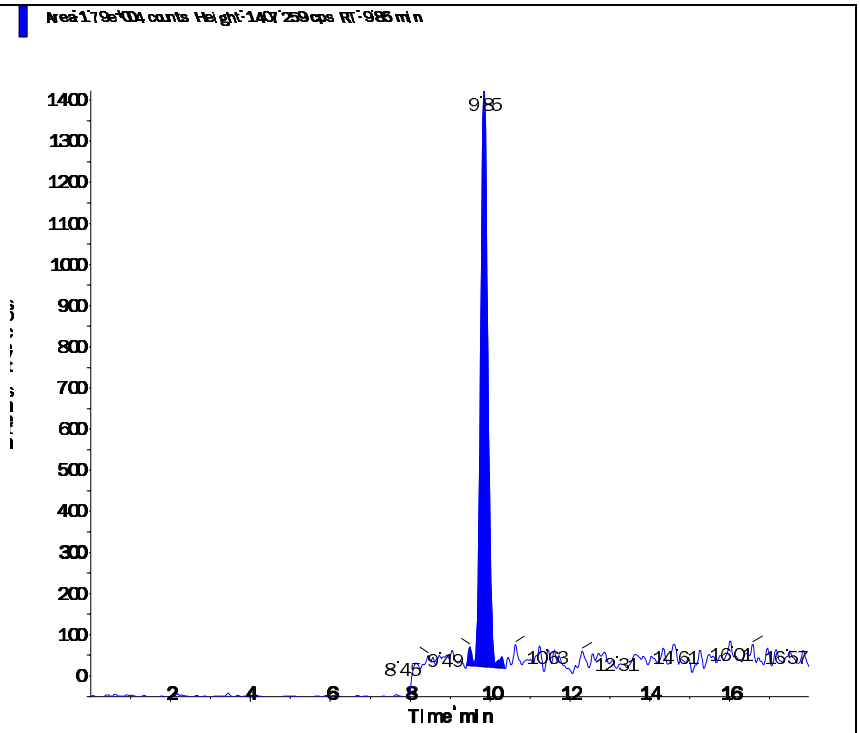
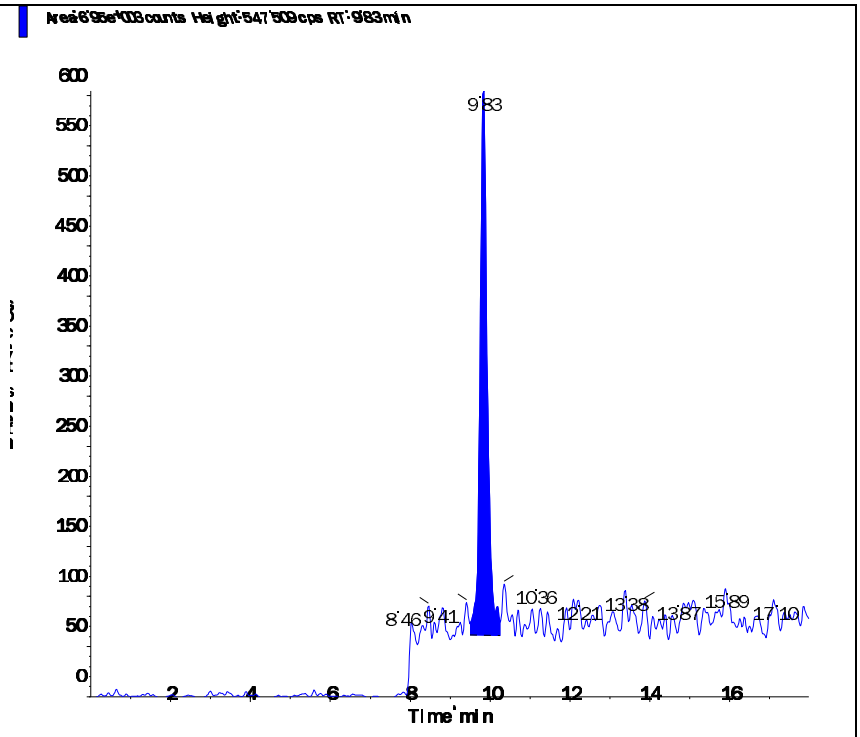
Perchlorate (98.8/83.3 amu)	
RT (Exp. RT): 9.85 (9.84) min Calculated conc: 0.103 ng/ml Area Ratio: 0.036 Sample Type: (Standard)	
Perchlorate conf (100.8/85.2 amu)	
RT (Exp. RT): 9.83 (9.84) min Calculated conc: 0.104 ng/ml Area Ratio: 0.014 Sample Type: (Standard)	

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Data File	LM34688.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	5/3/2016 3:43:59 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

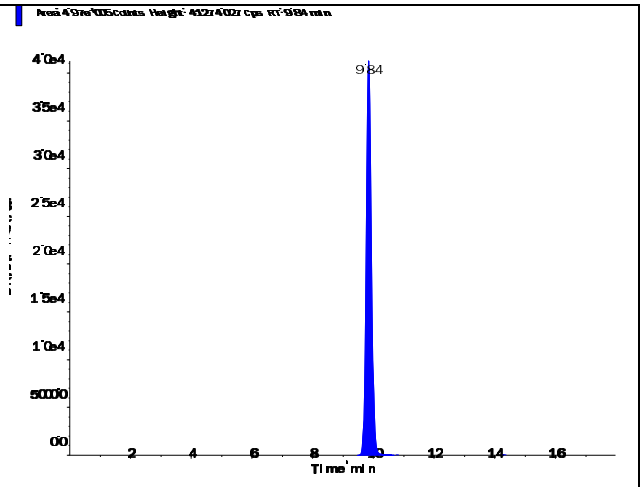
Sample Name	WG567320-03 STD (0.2 ug/L)	**Injection Vial**	3.00
Data File	LM34688.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 3:43:59 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Standard
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG567320-03	**Dilution Factor**	1.00
Sample Comment	1,1 STD75510	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.970e+05	9.84	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	3.410e+04	9.85	0.20	0.201
Perchlorate conf	1.190e+04	9.84	0.20	0.194

O18LP (Internal Standard)

RT (Exp. RT): 9.84(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Standard)



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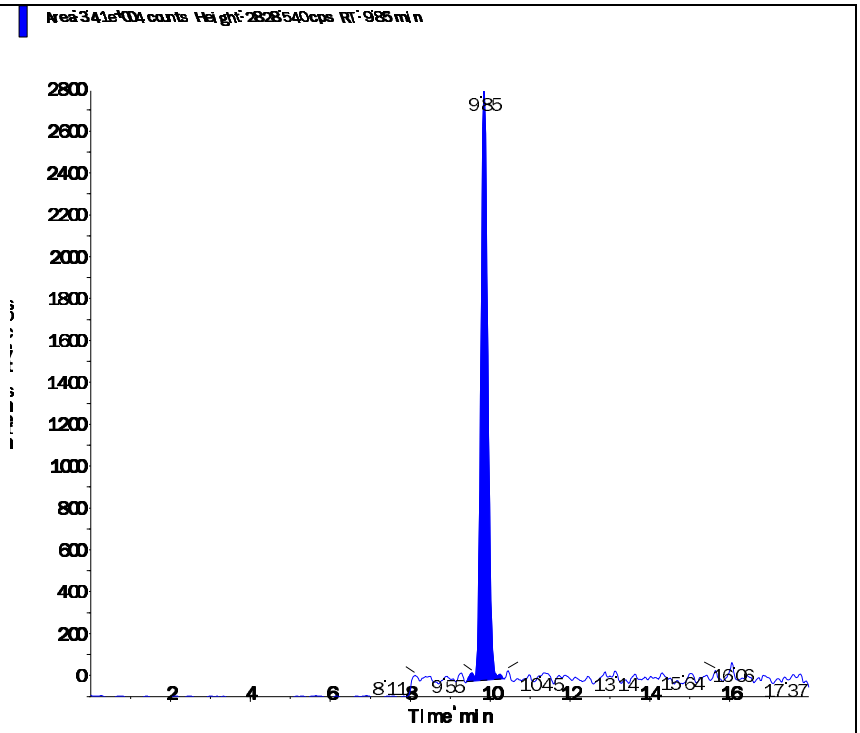
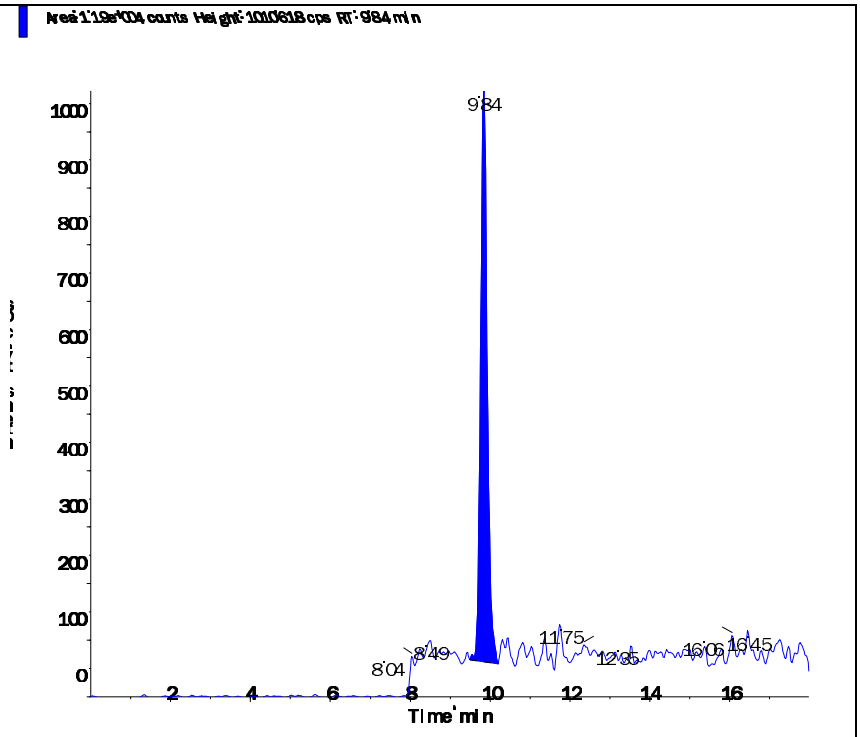
Perchlorate (98.8/83.3 amu)	
RT (Exp. RT):	9.85 (9.84) min
Calculated conc:	0.201 ng/ml
Area Ratio:	0.069
Sample Type:	(Standard)



Perchlorate conf (100.8/85.2 amu)	
RT (Exp. RT):	9.84 (9.84) min
Calculated conc:	0.194 ng/ml
Area Ratio:	0.024
Sample Type:	(Standard)



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Data File	LM34689.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	5/3/2016 4:02:52 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

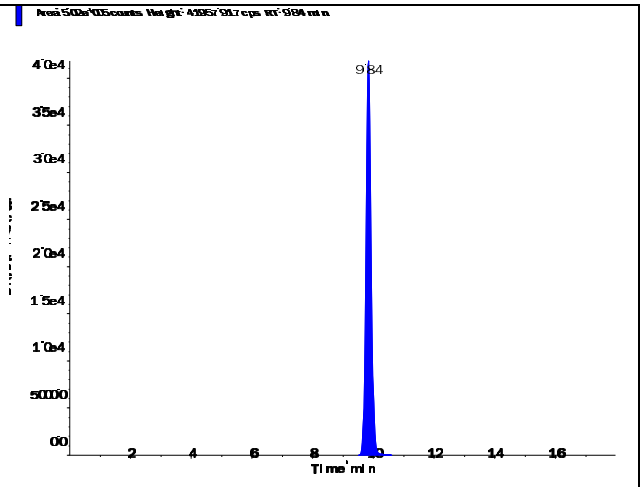
Sample Name	WG567320-04 STD (0.5 ug/L)	**Injection Vial**	4.00
Data File	LM34689.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 4:02:52 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Standard
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG567320-04	**Dilution Factor**	1.00
Sample Comment	1,1 STD75510	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.020e+05	9.84	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	8.220e+04	9.85	0.50	0.483
Perchlorate conf	2.940e+04	9.84	0.50	0.503

O18LP (Internal Standard)

RT (Exp. RT): 9.84(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Standard)



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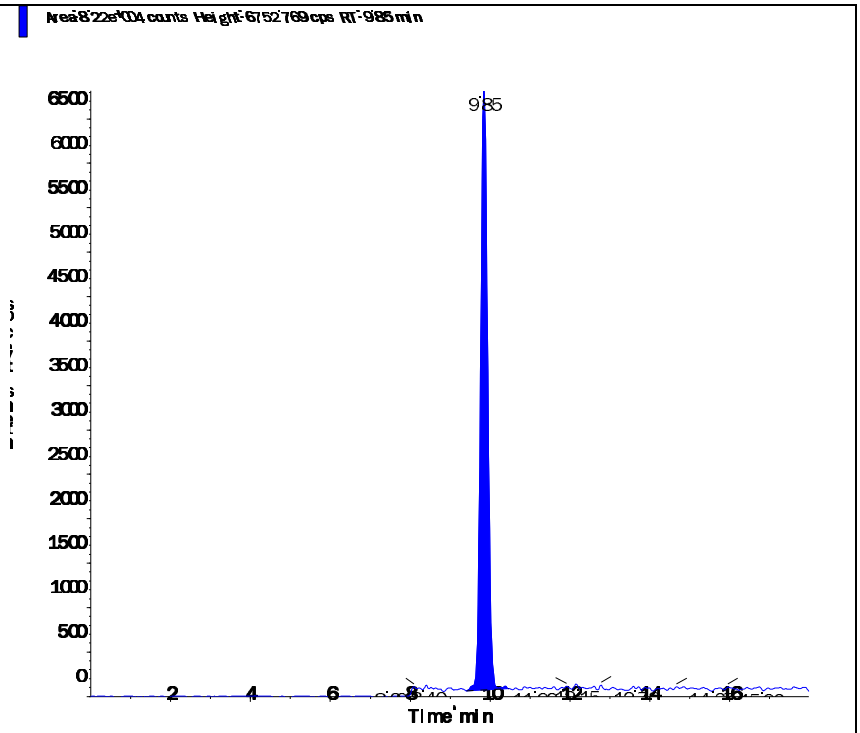
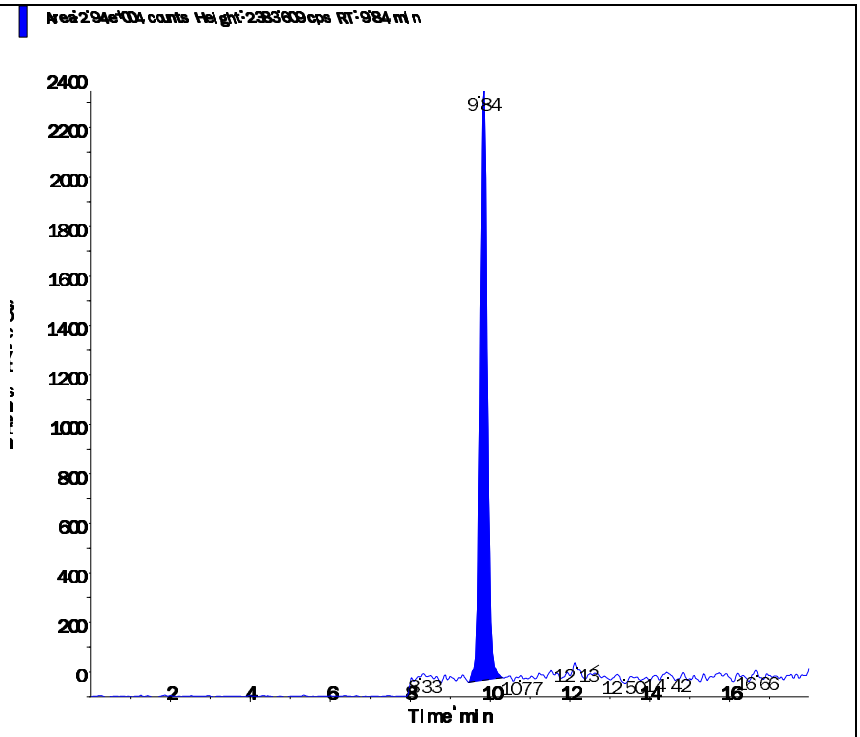
Perchlorate (98.8/83.3 amu)	
RT (Exp. RT):	9.85 (9.84) min
Calculated conc:	0.483 ng/ml
Area Ratio:	0.164
Sample Type:	(Standard)



Perchlorate conf (100.8/85.2 amu)	
RT (Exp. RT):	9.84 (9.84) min
Calculated conc:	0.503 ng/ml
Area Ratio:	0.058
Sample Type:	(Standard)



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Data File	LM34690.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	5/3/2016 4:21:49 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

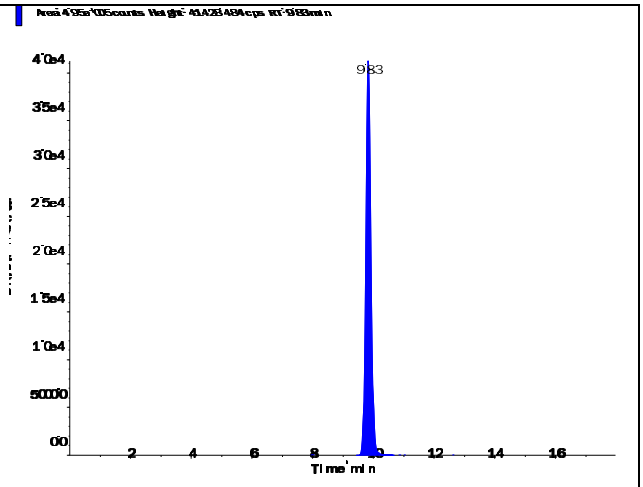
Sample Name	WG567320-05 STD (1.0 ug/L)	**Injection Vial**	5.00
Data File	LM34690.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 4:21:49 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Standard
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG567320-05	**Dilution Factor**	1.00
Sample Comment	1,1 STD75510	**Weight to Volume**	0.00

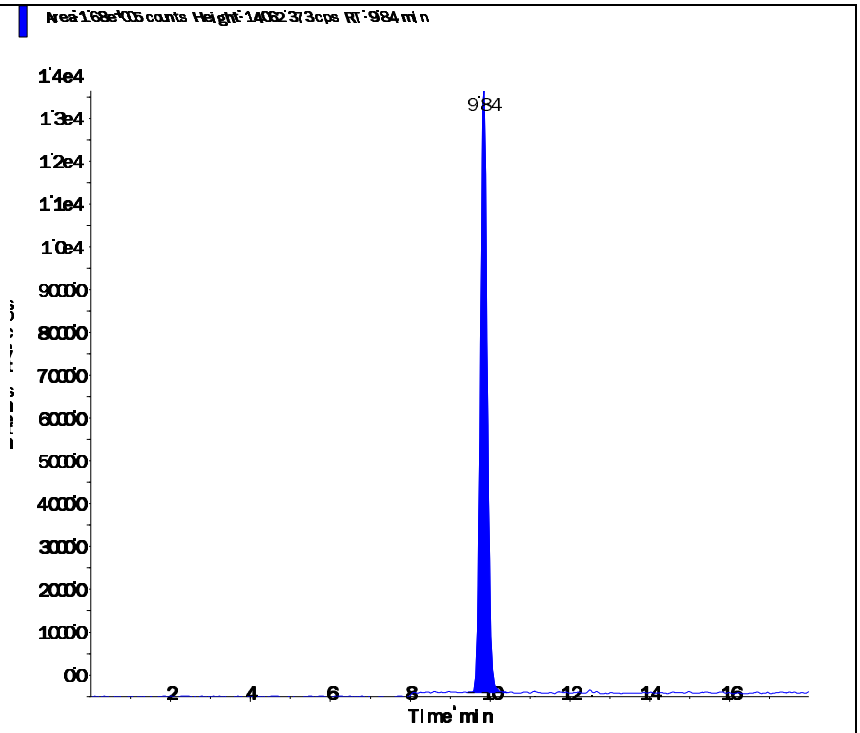
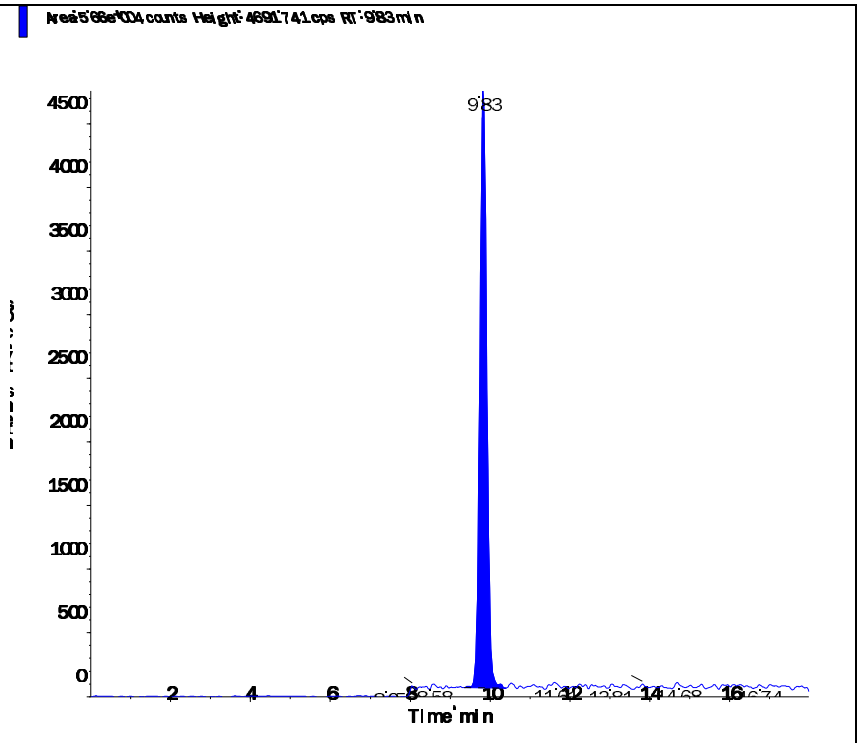
Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.950e+05	9.83	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	1.680e+05	9.84	1.00	1.01
Perchlorate conf	5.660e+04	9.83	1.00	1.00

O18LP (Internal Standard)

RT (Exp. RT): 9.83(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Standard)



Perchlorate (98.8/83.3 amu) RT (Exp. RT): 9.84 (9.84) min Calculated conc: 1.01 ng/ml Area Ratio: 0.339 Sample Type: (Standard)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 9.83 (9.84) min Calculated conc: 1.00 ng/ml Area Ratio: 0.114 Sample Type: (Standard)	

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Data File	LM34691.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	5/3/2016 4:40:45 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

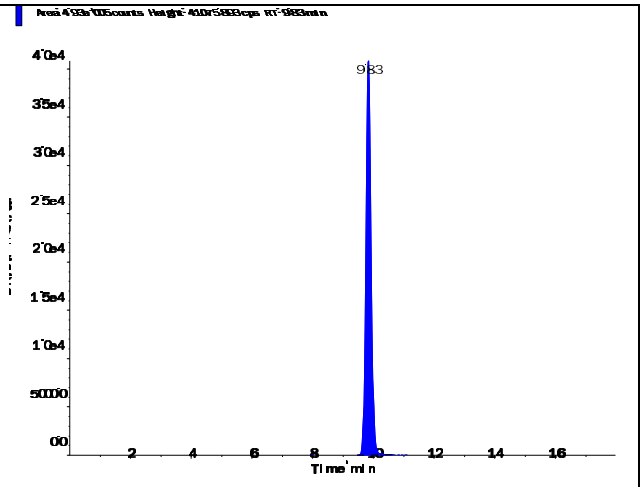
Sample Name	WG567320-06 STD (2.0 ug/L)	**Injection Vial**	6.00
Data File	LM34691.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 4:40:45 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Standard
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG567320-06	**Dilution Factor**	1.00
Sample Comment	1,1 STD75510	**Weight to Volume**	0.00

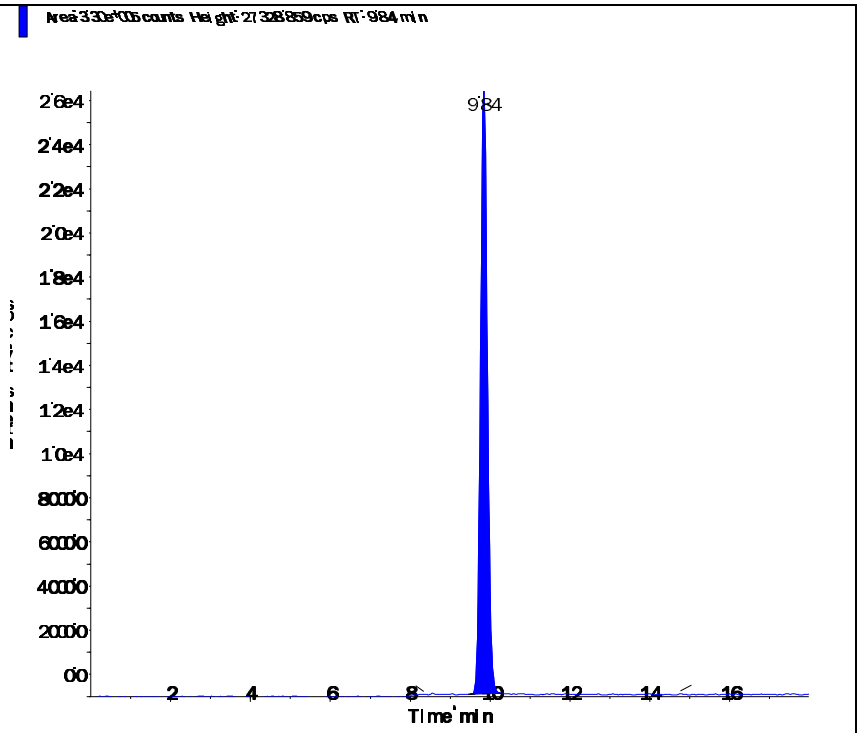
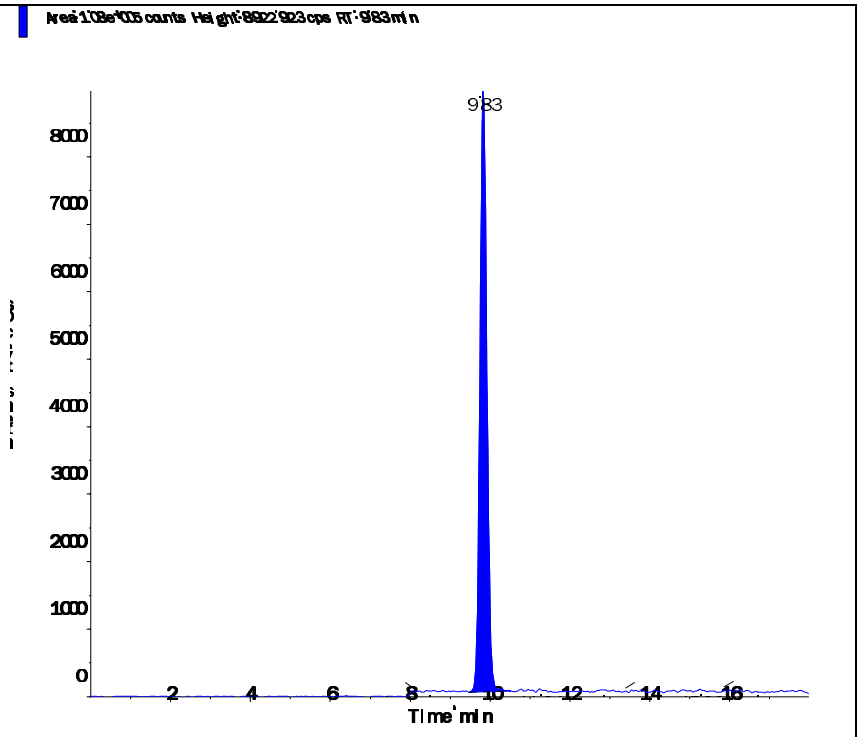
Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.930e+05	9.83	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	3.300e+05	9.84	2.00	1.99
Perchlorate conf	1.080e+05	9.83	2.00	1.94

O18LP (Internal Standard)

RT (Exp. RT): 9.83(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Standard)



Perchlorate (98.8/83.3 amu) RT (Exp. RT): 9.84 (9.84) min Calculated conc: 1.99 ng/ml Area Ratio: 0.669 Sample Type: (Standard)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 9.83 (9.84) min Calculated conc: 1.94 ng/ml Area Ratio: 0.219 Sample Type: (Standard)	

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Data File	LM34692.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	5/3/2016 4:59:42 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

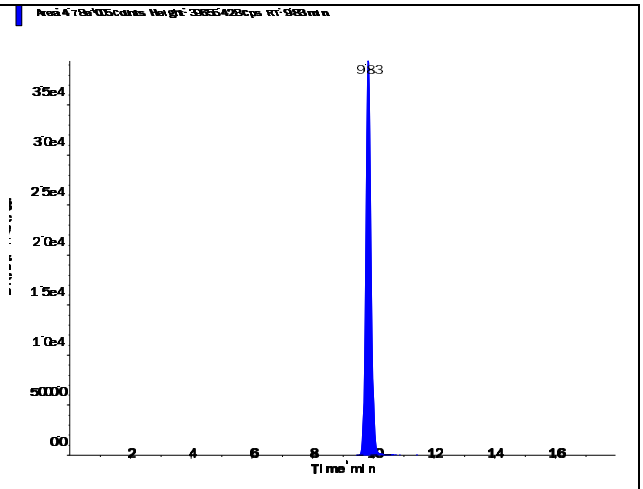
Sample Name	WG567320-07 STD (5.0 ug/L)	**Injection Vial**	7.00
Data File	LM34692.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 4:59:42 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Standard
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG567320-07	**Dilution Factor**	1.00
Sample Comment	1,1 STD75510	**Weight to Volume**	0.00

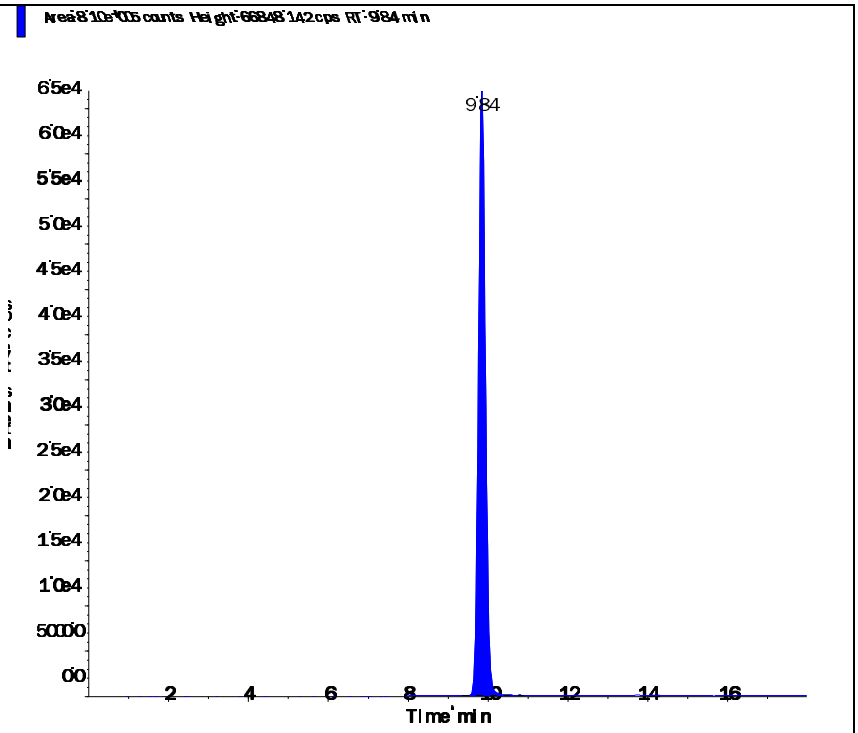
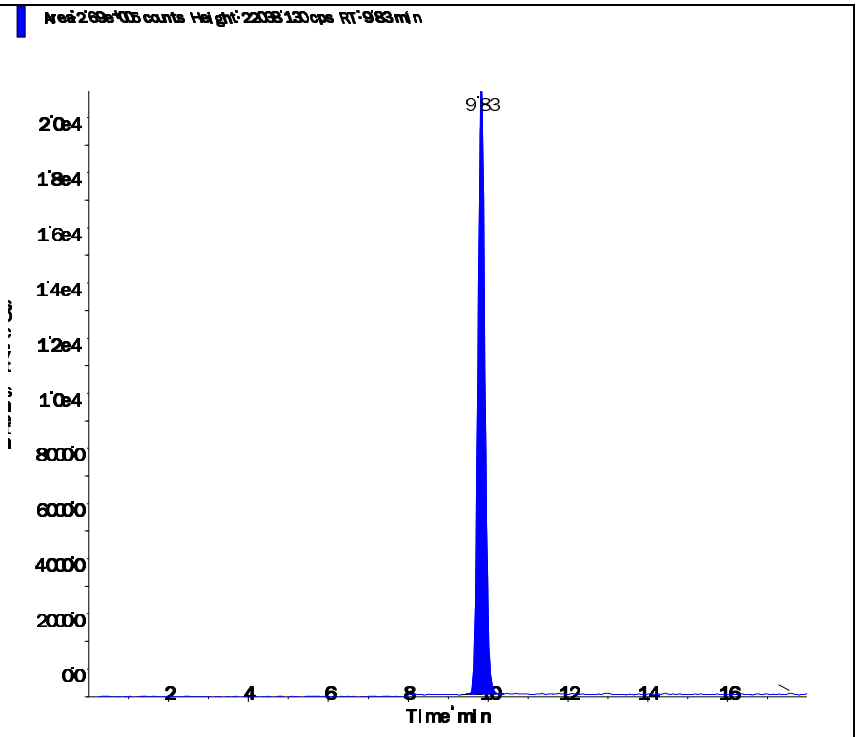
Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.780e+05	9.83	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	8.100e+05	9.84	5.00	5.04
Perchlorate conf	2.690e+05	9.83	5.00	5.02

O18LP (Internal Standard)

RT (Exp. RT): 9.83(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Standard)



Perchlorate (98.8/83.3 amu) RT (Exp. RT): 9.84 (9.84) min Calculated conc: 5.04 ng/ml Area Ratio: 1.695 Sample Type: (Standard)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 9.83 (9.84) min Calculated conc: 5.02 ng/ml Area Ratio: 0.562 Sample Type: (Standard)	

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Data File	LM34693.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	5/3/2016 5:18:37 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

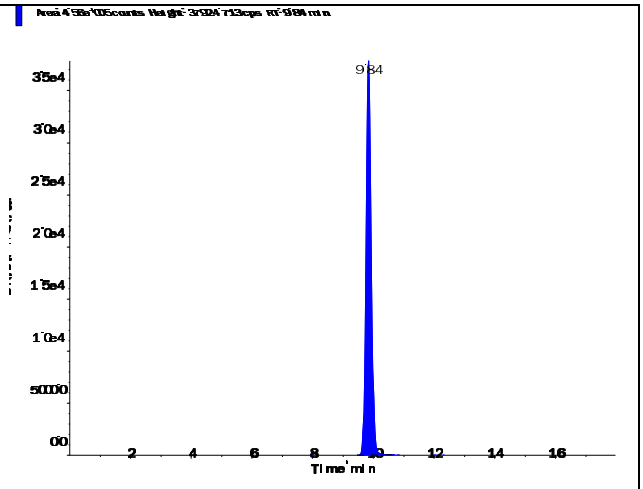
Sample Name	WG567320-08 STD (10 ug/L)	**Injection Vial**	8.00
Data File	LM34693.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 5:18:37 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Standard
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG567320-08	**Dilution Factor**	1.00
Sample Comment	1,1 STD75510	**Weight to Volume**	0.00

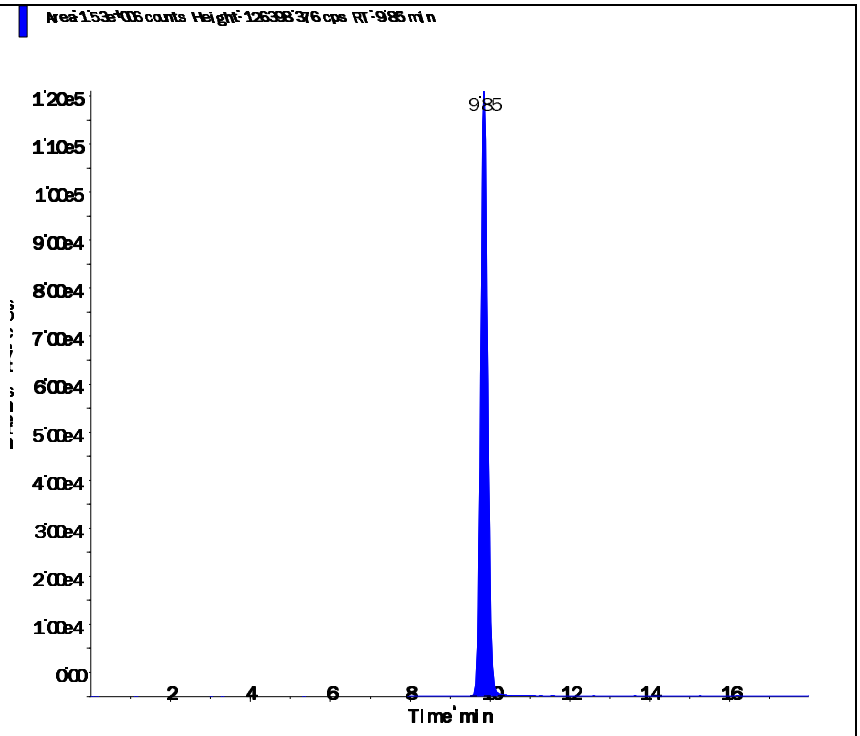
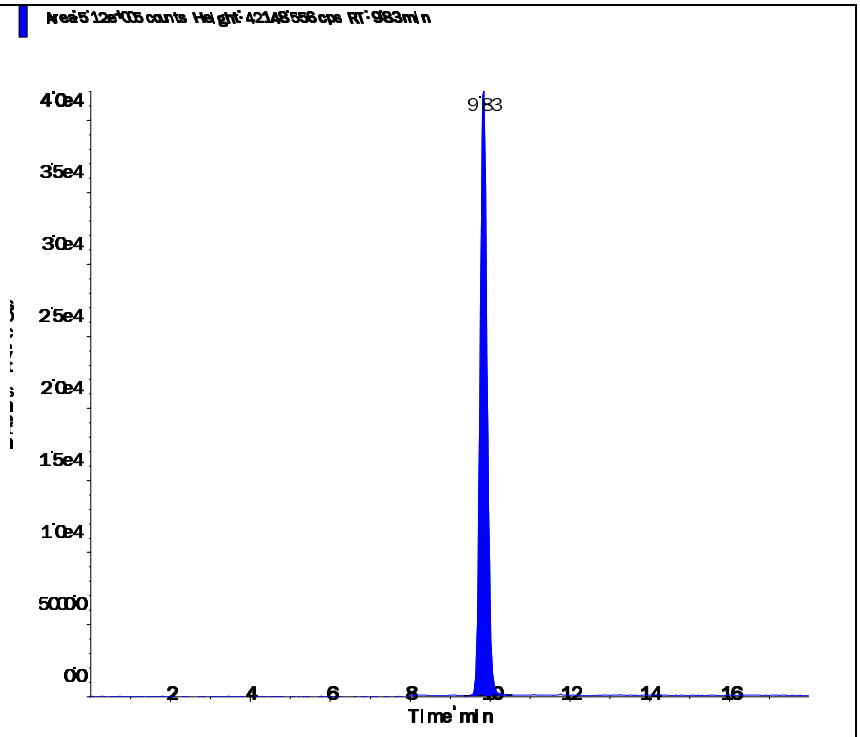
Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.560e+05	9.84	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	1.530e+06	9.85	10.00	9.99
Perchlorate conf	5.120e+05	9.83	10.00	10.00

O18LP (Internal Standard)

RT (Exp. RT): 9.84(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Standard)



Perchlorate (98.8/83.3 amu) RT (Exp. RT): 9.85 (9.84) min Calculated conc: 9.99 ng/ml Area Ratio: 3.36 Sample Type: (Standard)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 9.83 (9.84) min Calculated conc: 10.00 ng/ml Area Ratio: 1.122 Sample Type: (Standard)	

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Data File	LM34694.wiff	**Result Table**	050316_JWR.rdb
Acquisition Date	5/3/2016 5:37:34 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

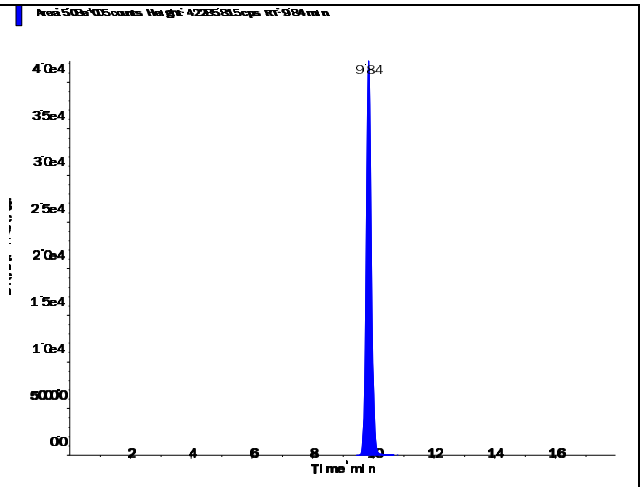
Sample Name	WG567320-09 SSCV (1.0 ug/L)	**Injection Vial**	9.00
Data File	LM34694.wiff	**Injection Volume**	10.00
Acquisition Date	5/3/2016 5:37:34 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Quality Control
Instrument Name	API 4000	**Result Table**	050316_JWR.rdb
Sample ID	WG567320-09	**Dilution Factor**	1.00
Sample Comment	1,1 STD75512	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.080e+05	9.84	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	1.690e+05	9.85	1.00	0.985
Perchlorate conf	5.630e+04	9.84	1.00	0.973

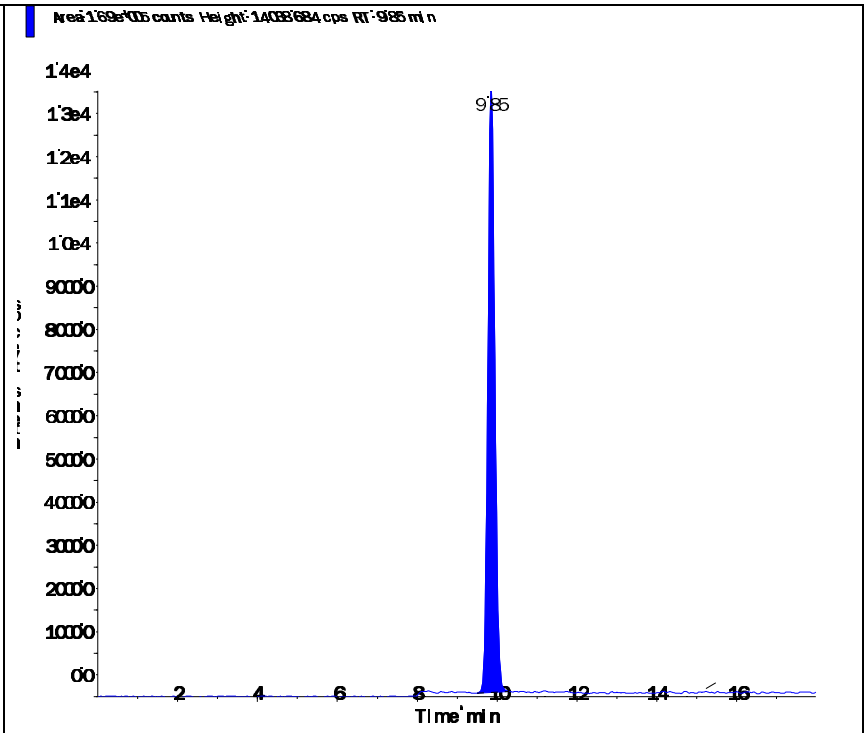
O18LP (Internal Standard)

RT (Exp. RT): 9.84(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Quality Control)



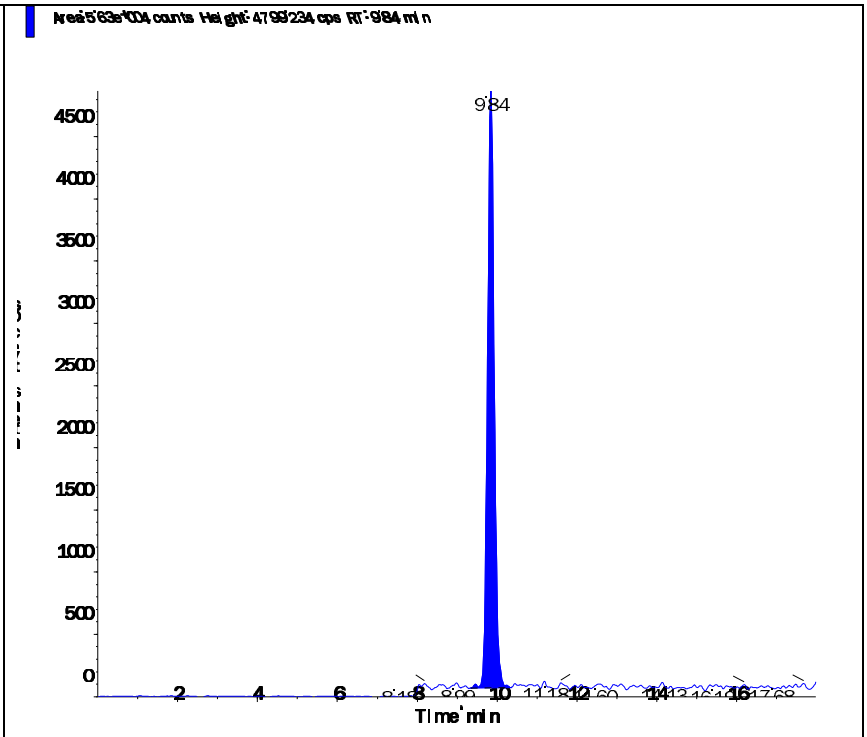
Perchlorate (98.8/83.3 amu)

RT (Exp. RT):	9.85 (9.84) min
Calculated conc:	0.985 ng/ml
Area Ratio:	0.332
Sample Type:	(Quality Control)



Perchlorate conf (100.8/85.2 amu)

RT (Exp. RT):	9.84 (9.84) min
Calculated conc:	0.973 ng/ml
Area Ratio:	0.111
Sample Type:	(Quality Control)



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Data File	LM37299.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 2:29:20 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

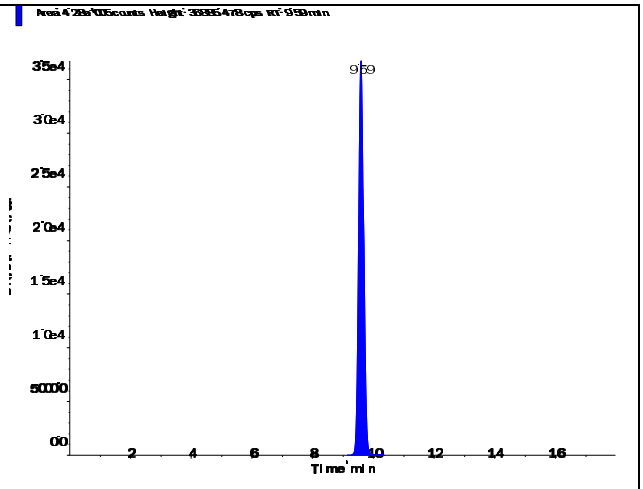
Sample Name	WG586942-02 CCV (1.0ug/L)	**Injection Vial**	3.00
Data File	LM37299.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 2:29:20 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Quality Control
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586942-02	**Dilution Factor**	1.00
Sample Comment	1,1 STD78249	**Weight to Volume**	0.00

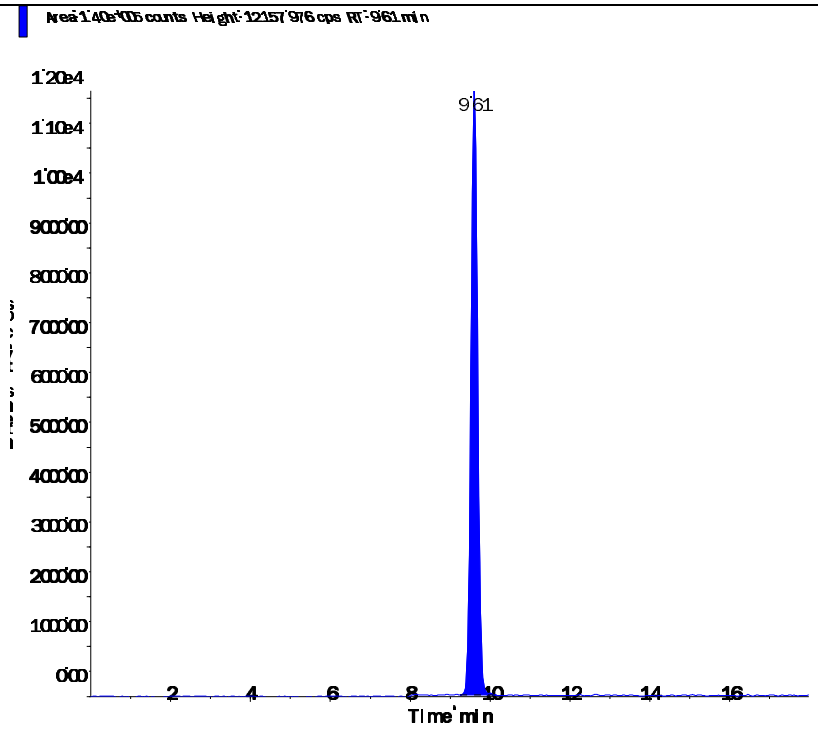
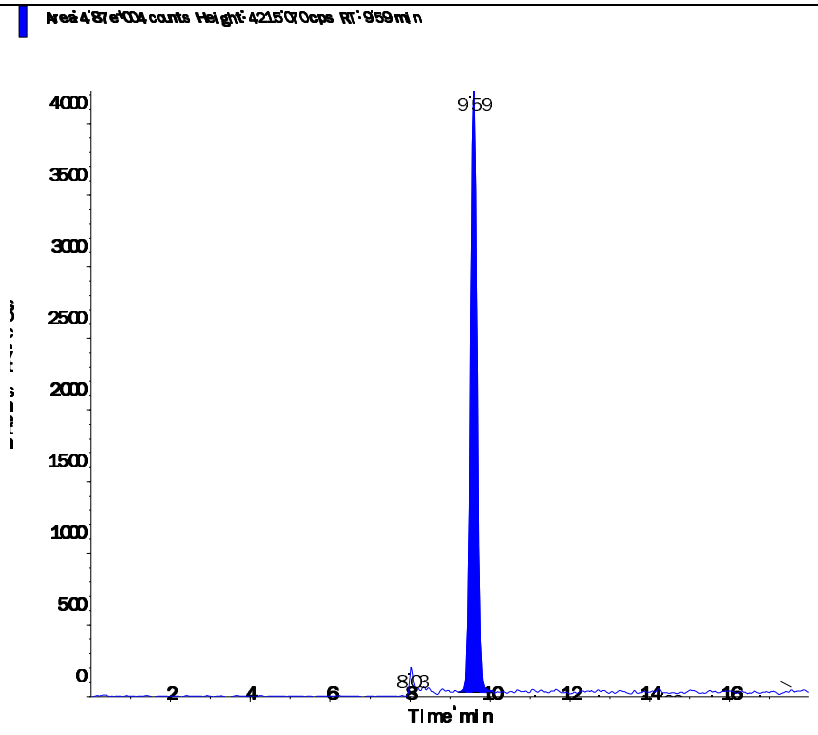
Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.280e+05	9.59	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	1.400e+05	9.61	1.00	0.972
Perchlorate conf	4.870e+04	9.59	1.00	1.00

O18LP (Internal Standard)

RT (Exp. RT): 9.59(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Quality Control)



Perchlorate (98.8/83.3 amu) RT (Exp. RT): 9.61 (9.84) min Calculated conc: 0.972 ng/ml Area Ratio: 0.328 Sample Type: (Quality Control)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 9.59 (9.84) min Calculated conc: 1.00 ng/ml Area Ratio: 0.114 Sample Type: (Quality Control)	

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Data File	LM37311.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 6:16:37 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

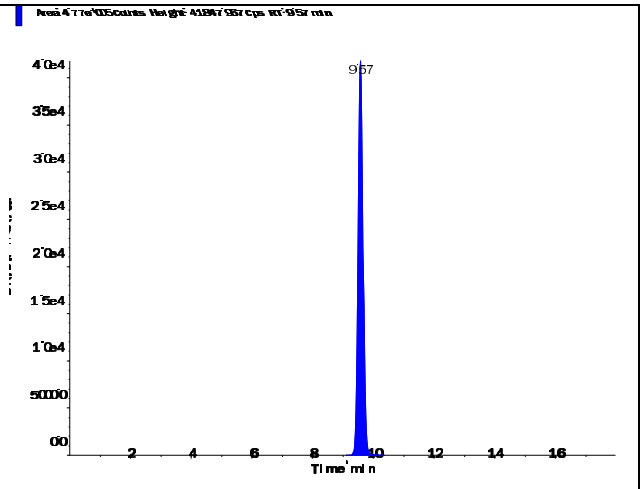
Sample Name	WG586942-03 CCV (1.0ug/L)	**Injection Vial**	3.00
Data File	LM37311.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 6:16:37 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Quality Control
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586942-03	**Dilution Factor**	1.00
Sample Comment	1,1 STD78249	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.770e+05	9.57	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	1.560e+05	9.59	1.00	0.97
Perchlorate conf	5.460e+04	9.57	1.00	1.01

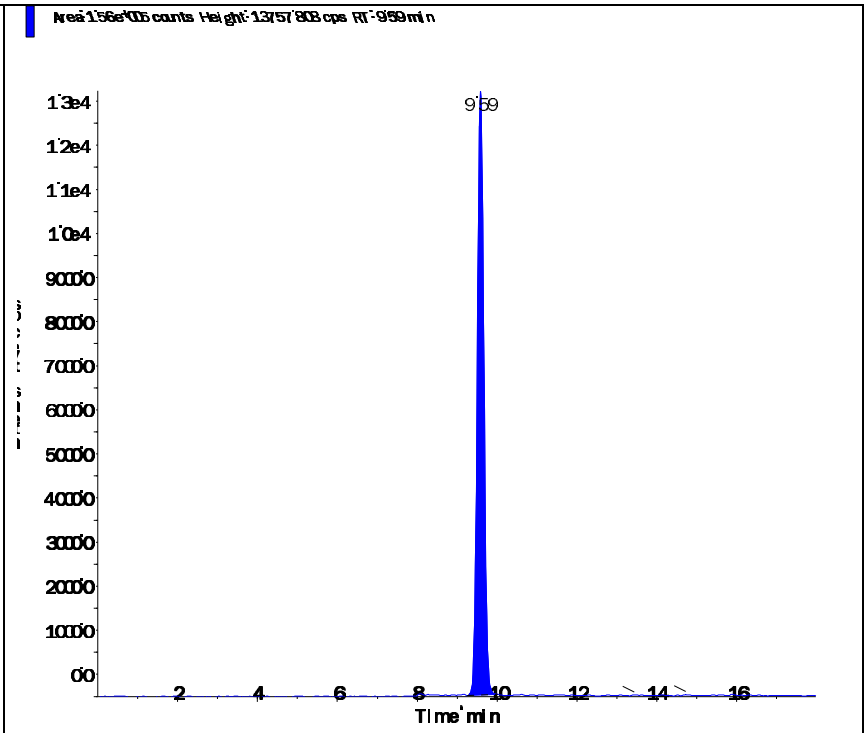
O18LP (Internal Standard)

RT (Exp. RT): 9.57(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Quality Control)



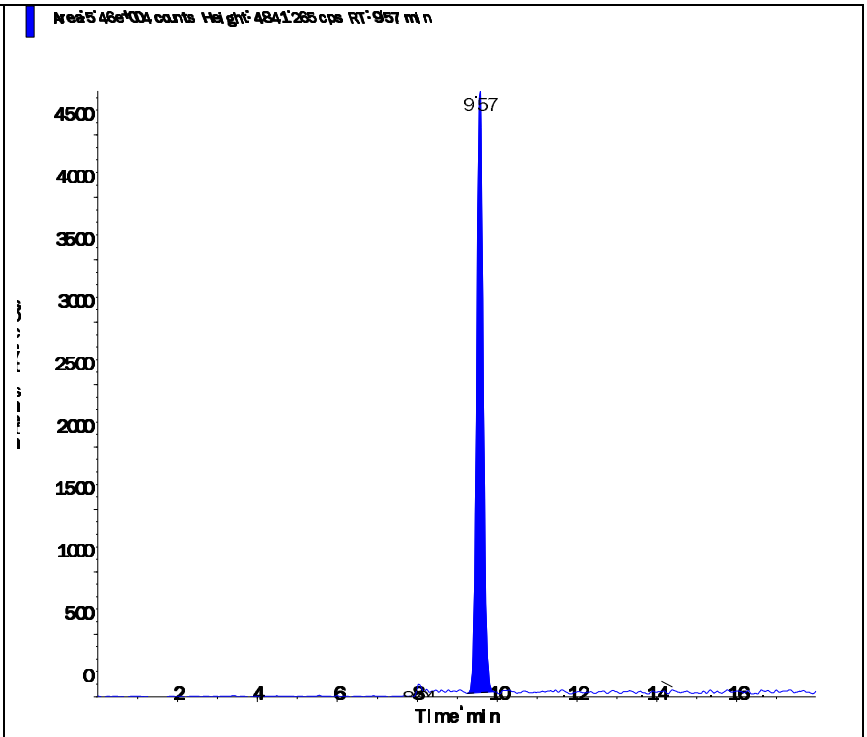
Perchlorate (98.8/83.3 amu)

RT (Exp. RT):	9.59 (9.84) min
Calculated conc:	0.97 ng/ml
Area Ratio:	0.327
Sample Type:	(Quality Control)



Perchlorate conf (100.8/85.2 amu)

RT (Exp. RT):	9.57 (9.84) min
Calculated conc:	1.01 ng/ml
Area Ratio:	0.114
Sample Type:	(Quality Control)



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Data File	LM37324.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 10:22:50 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

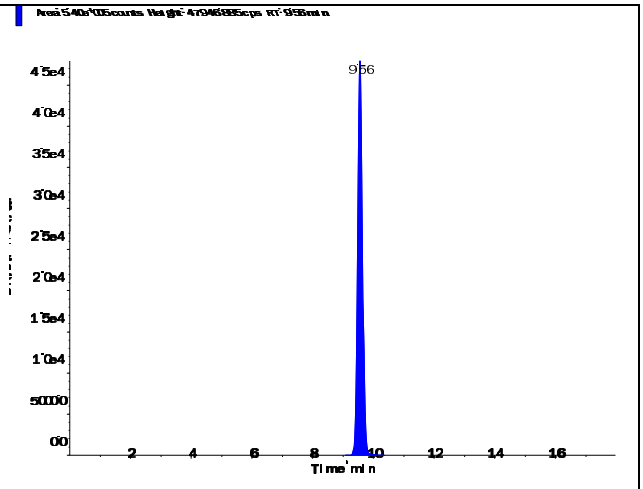
Sample Name	WG586942-05 CCV (1.0ug/L)	**Injection Vial**	3.00
Data File	LM37324.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 10:22:50 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Quality Control
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586942-05	**Dilution Factor**	1.00
Sample Comment	1,1 STD78249	**Weight to Volume**	0.00

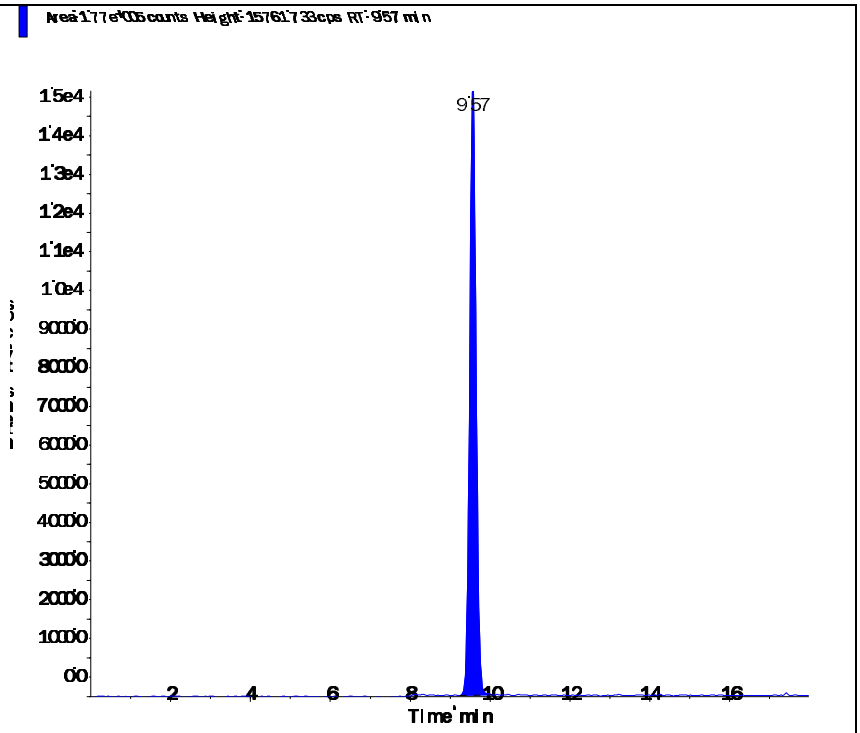
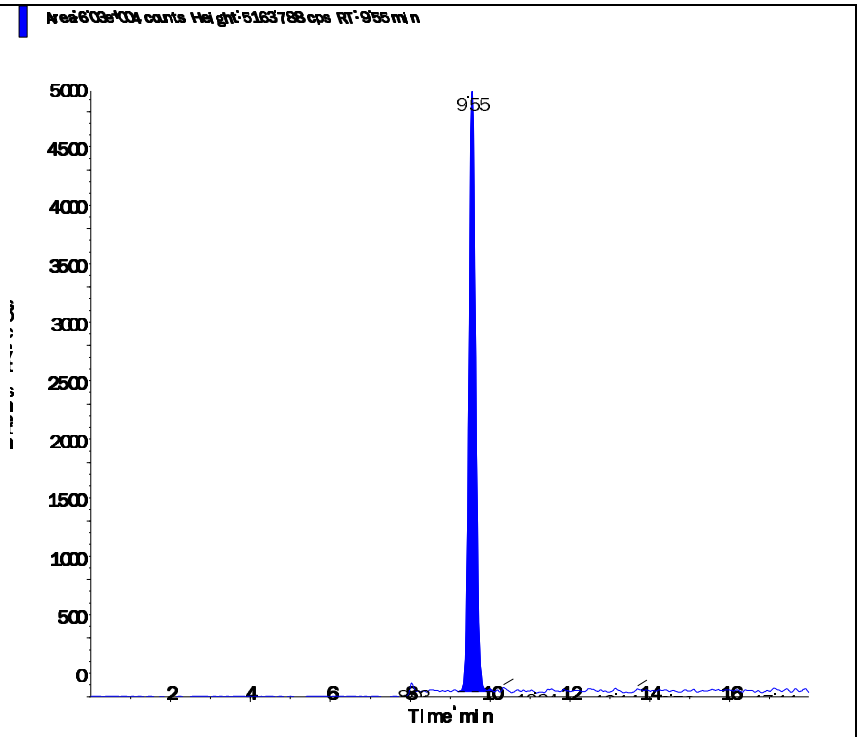
Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.400e+05	9.56	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	1.770e+05	9.57	1.00	0.969
Perchlorate conf	6.030e+04	9.55	1.00	0.979

O18LP (Internal Standard)

RT (Exp. RT): 9.56(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Quality Control)



Perchlorate (98.8/83.3 amu) RT (Exp. RT): 9.57 (9.84) min Calculated conc: 0.969 ng/ml Area Ratio: 0.327 Sample Type: (Quality Control)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 9.55 (9.84) min Calculated conc: 0.979 ng/ml Area Ratio: 0.112 Sample Type: (Quality Control)	

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Data File	LM37300.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 2:48:17 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

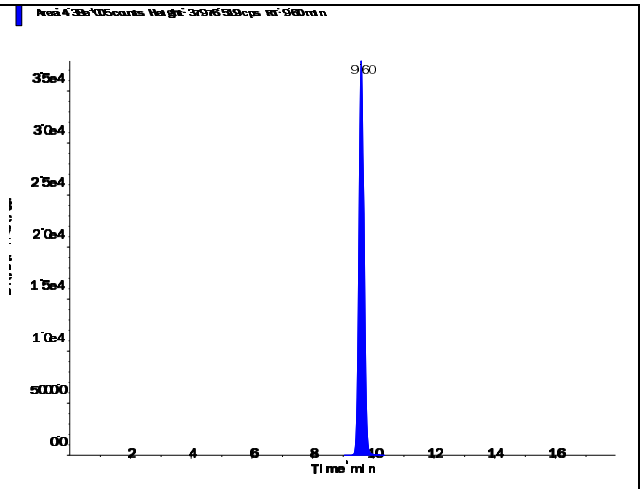
Sample Name	WG586928-10 MRL (0.2ug/L)	**Injection Vial**	2.00
Data File	LM37300.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 2:48:17 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-10	**Dilution Factor**	1.00
Sample Comment	1,1 STD78249	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.380e+05	9.60	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	3.070e+04	9.61	N/A	0.205
Perchlorate conf	1.110e+04	9.61	N/A	0.207

O18LP (Internal Standard)

RT (Exp. RT): 9.60(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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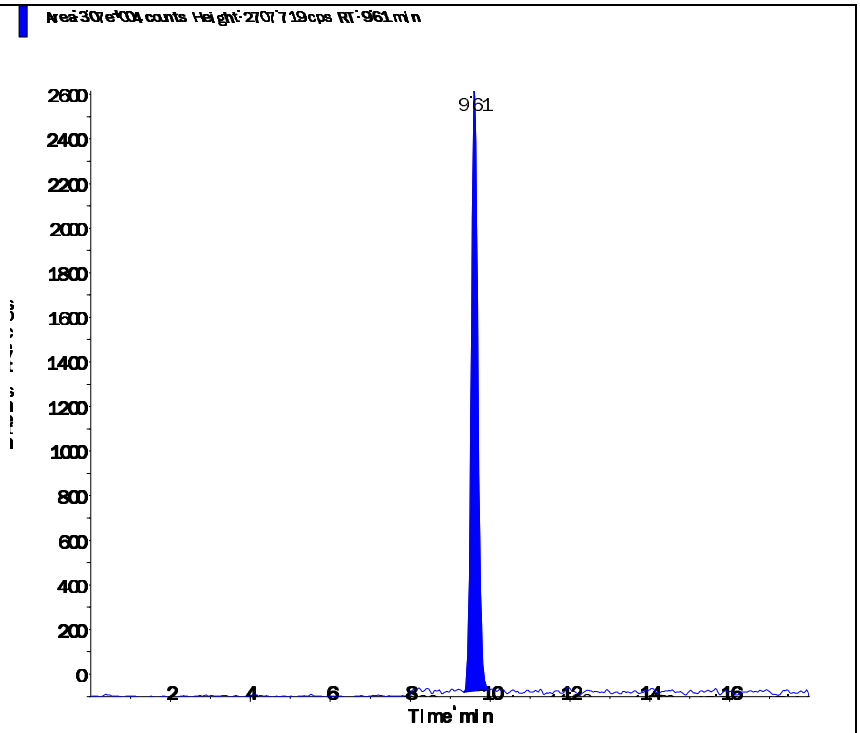
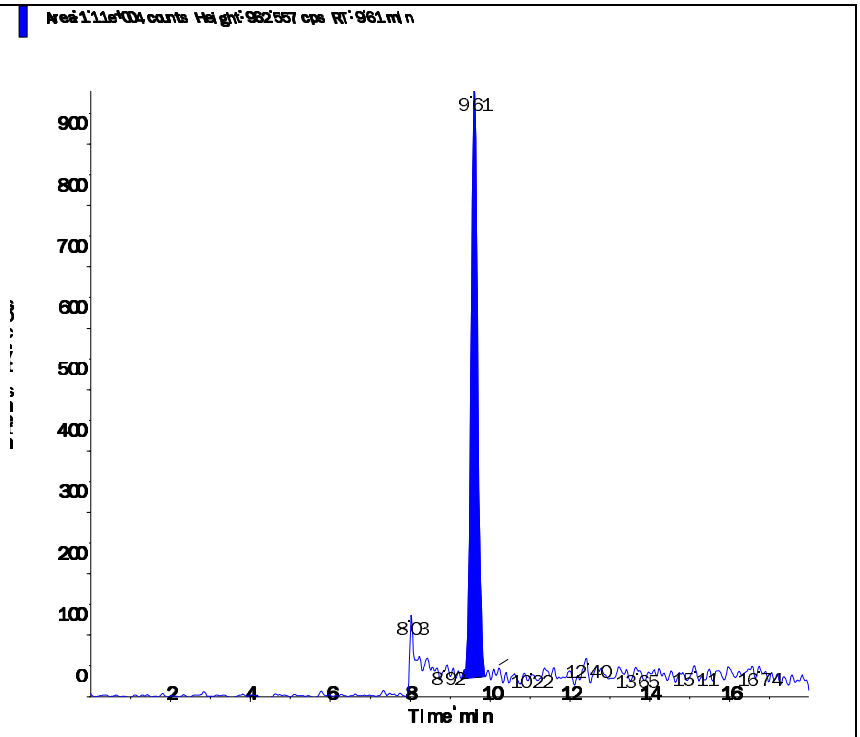
Perchlorate (98.8/83.3 amu)	
RT (Exp. RT):	9.61 (9.84) min
Calculated conc:	0.205 ng/ml
Area Ratio:	0.07
Sample Type:	(Unknown)



Perchlorate conf (100.8/85.2 amu)	
RT (Exp. RT):	9.61 (9.84) min
Calculated conc:	0.207 ng/ml
Area Ratio:	0.025
Sample Type:	(Unknown)



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Data File	LM37312.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 6:35:34 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

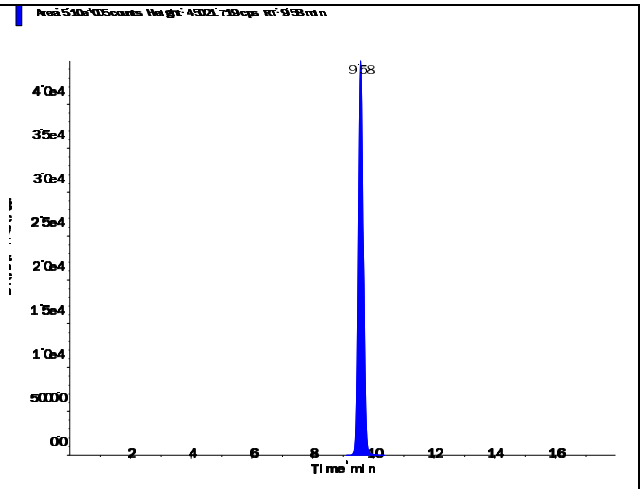
Sample Name	WG586928-11 MRL (0.2ug/L)	**Injection Vial**	2.00
Data File	LM37312.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 6:35:34 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-11	**Dilution Factor**	1.00
Sample Comment	1,1 STD78249	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.100e+05	9.58	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	3.620e+04	9.59	N/A	0.207
Perchlorate conf	1.230e+04	9.58	N/A	0.196

O18LP (Internal Standard)

RT (Exp. RT): 9.58(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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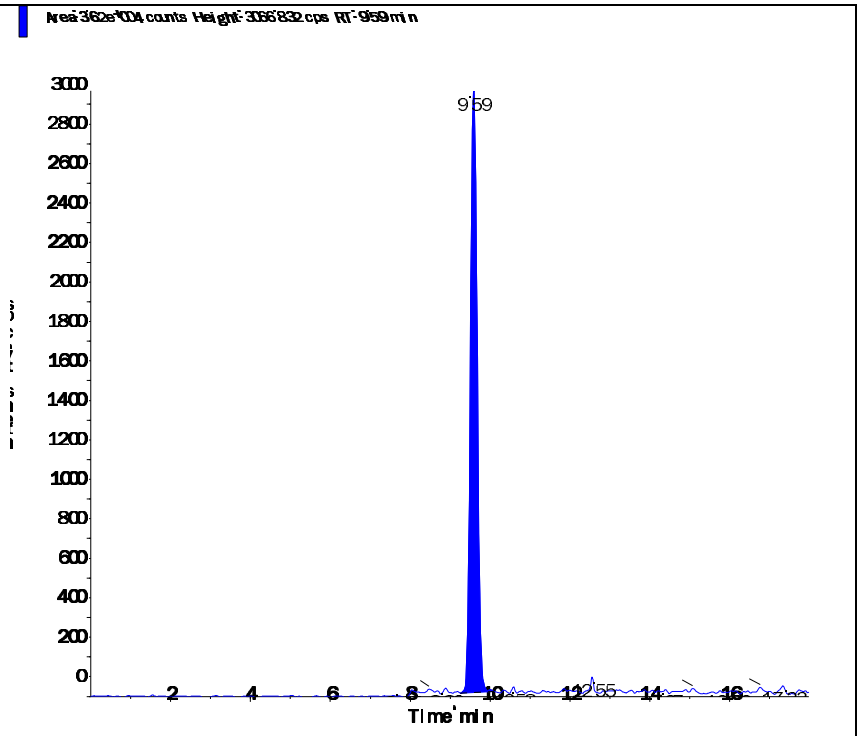
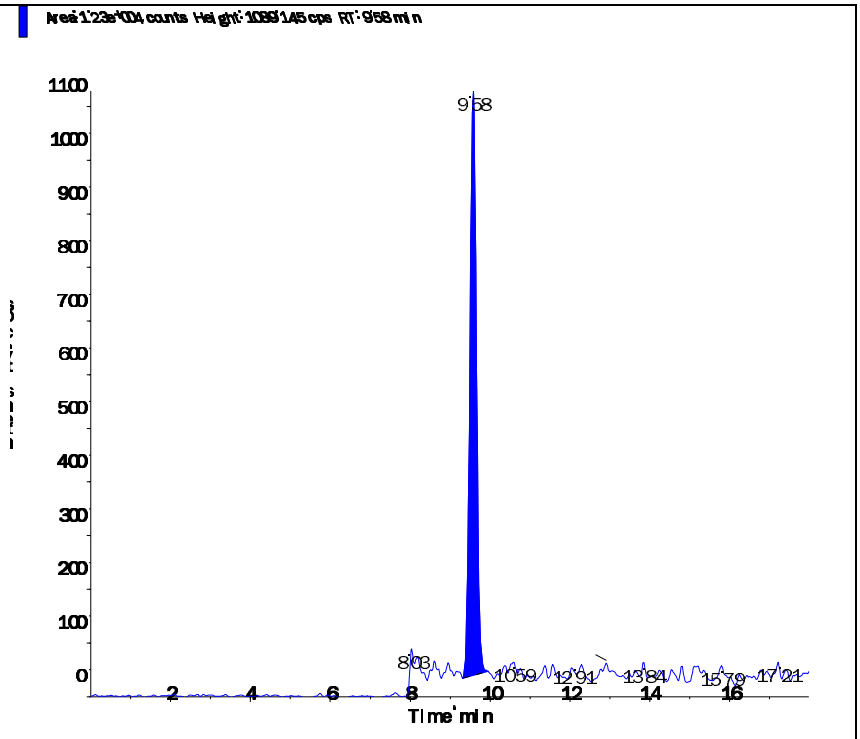
Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.59 (9.84) min 0.207 ng/ml 0.071 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.58 (9.84) min 0.196 ng/ml 0.024 (Unknown)



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Data File	LM37325.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 10:41:45 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

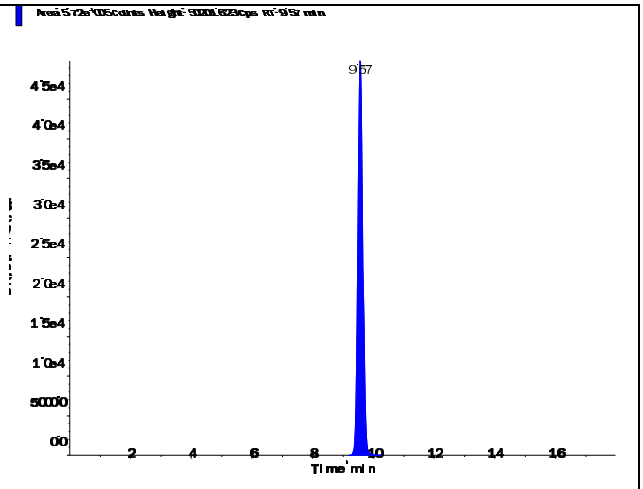
Sample Name	WG586928-12 MRL (0.2ug/L)	**Injection Vial**	2.00
Data File	LM37325.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 10:41:45 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-12	**Dilution Factor**	1.00
Sample Comment	1,1 STD78249	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.720e+05	9.57	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	4.110e+04	9.58	N/A	0.21
Perchlorate conf	1.410e+04	9.56	N/A	0.20

O18LP (Internal Standard)

RT (Exp. RT): 9.57(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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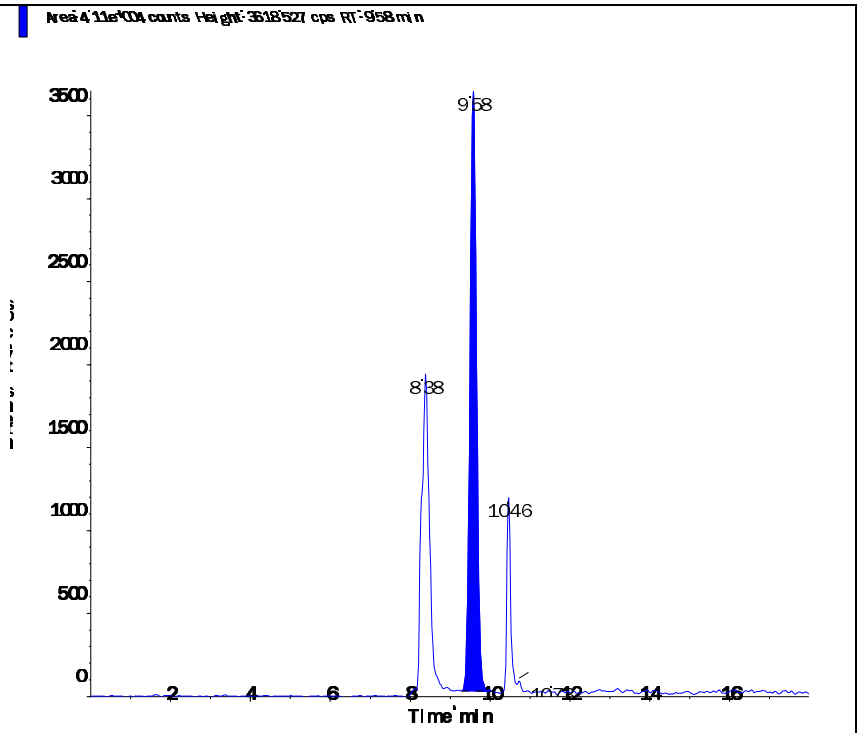
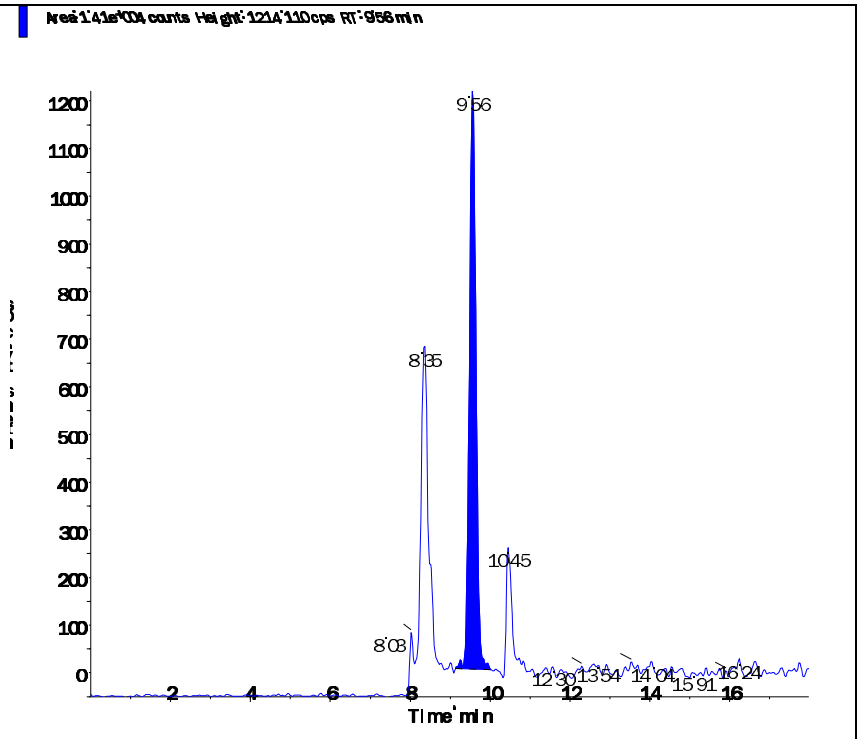
Created with Analyst Reporter
Printed: 10/11/2016 11:47 AM

Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.58 (9.84) min 0.21 ng/ml 0.072 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 9.56 (9.84) min 0.20 ng/ml 0.025 (Unknown)



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Created with Analyst Reporter
Printed: 10/11/2016 11:38 AM

Data File	LM37298.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 2:10:30 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

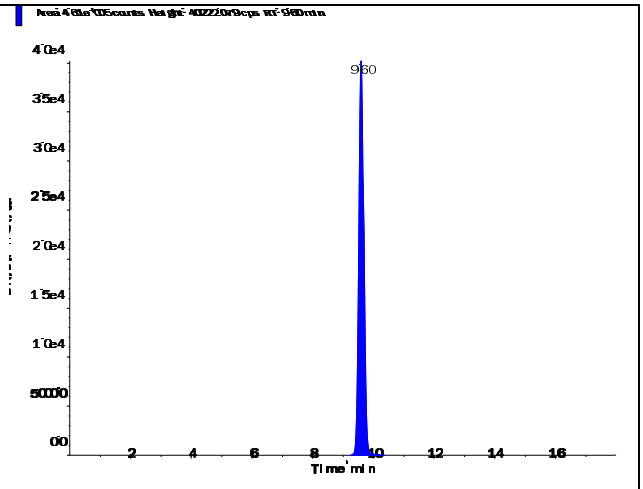
Sample Name	WG586942-01 CCB	**Injection Vial**	1.00
Data File	LM37298.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 2:10:30 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586942-01	**Dilution Factor**	1.00
Sample Comment	11.00	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.610e+05	9.60	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	0.000e+00	0.00	N/A	No Peak
Perchlorate conf	0.000e+00	0.00	N/A	No Peak

O18LP (Internal Standard)

RT (Exp. RT): 9.60(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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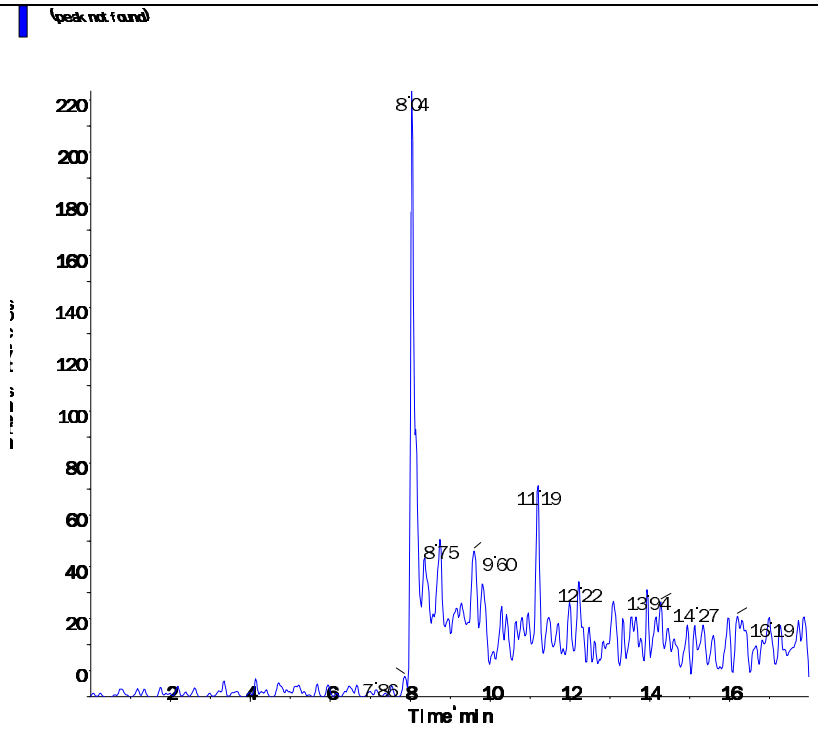
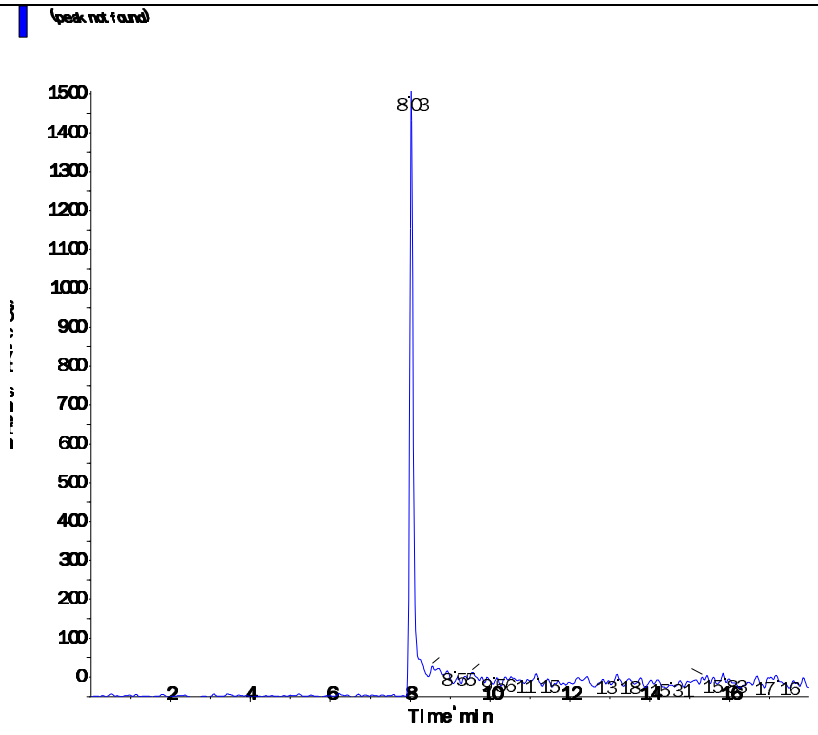
Created with Analyst Reporter
Printed: 10/11/2016 11:38 AM

Perchlorate (98.8/83.3 amu) RT (Exp. RT): 0.00 (9.84) min Calculated conc: No Peak ng/ml Area Ratio: 0.00 Sample Type: (Unknown)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 0.00 (9.84) min Calculated conc: No Peak ng/ml Area Ratio: 0.00 Sample Type: (Unknown)	

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Created with Analyst Reporter
Printed: 10/11/2016 11:43 AM

Data File	LM37313.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 6:54:29 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

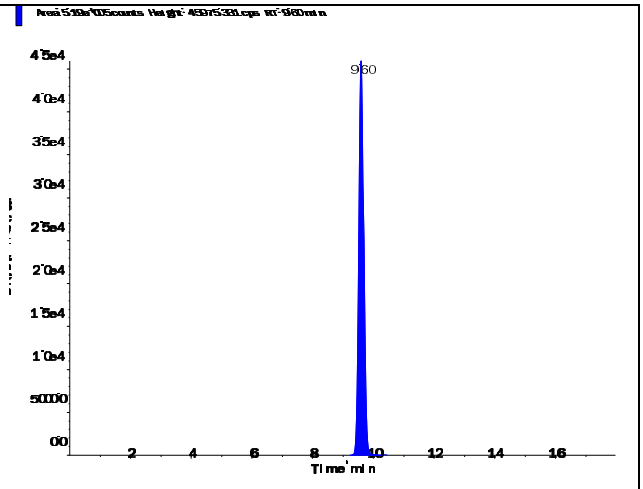
Sample Name	WG586942-04 CCB	**Injection Vial**	1.00
Data File	LM37313.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 6:54:29 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586942-04	**Dilution Factor**	1.00
Sample Comment	11.00	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.190e+05	9.60	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	0.000e+00	0.00	N/A	No Peak
Perchlorate conf	0.000e+00	0.00	N/A	No Peak

O18LP (Internal Standard)

RT (Exp. RT): 9.60(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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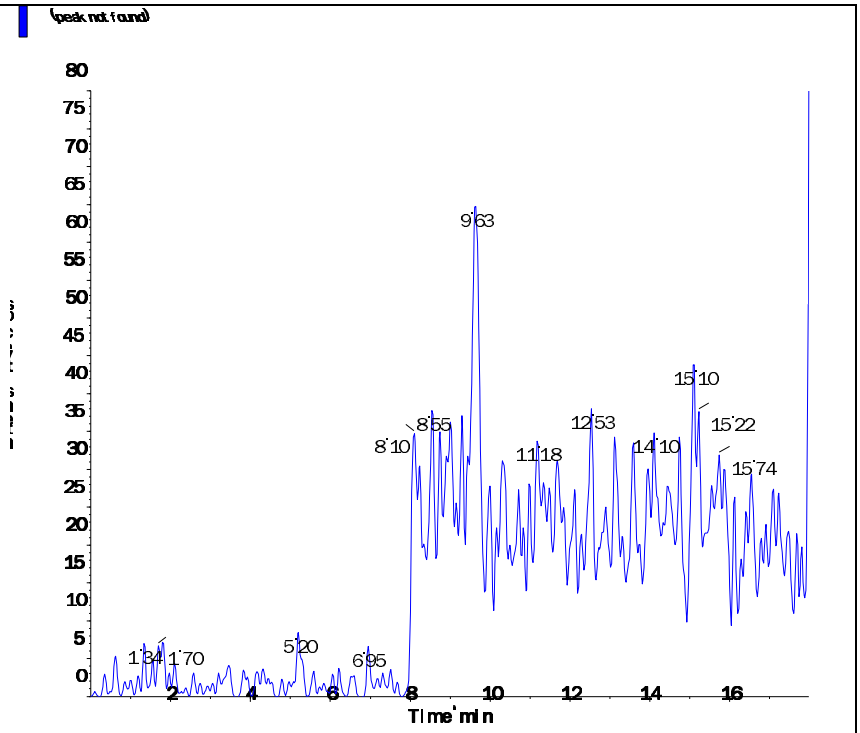
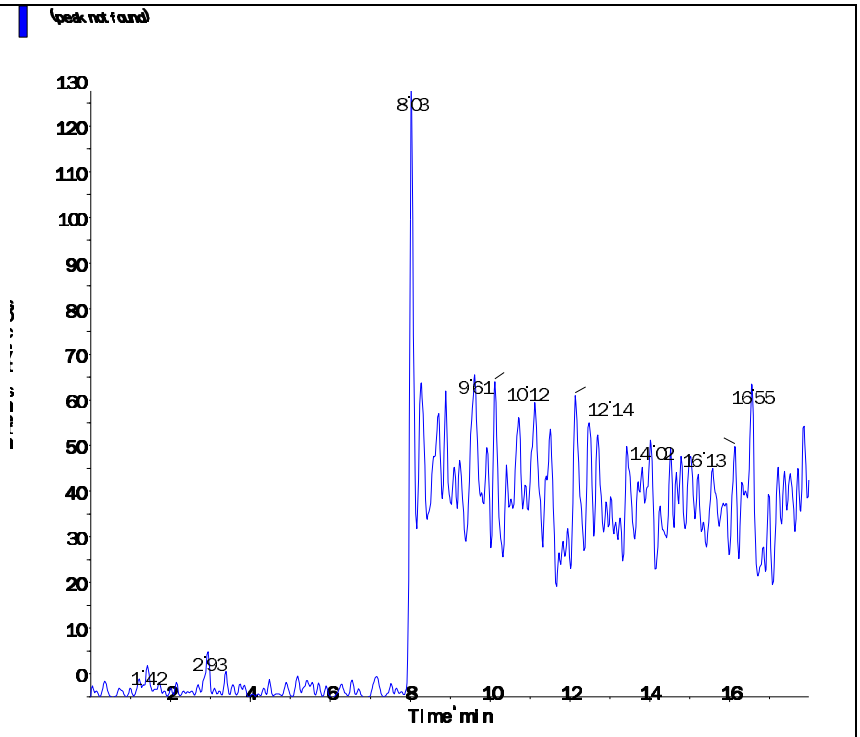
Created with Analyst Reporter
Printed: 10/11/2016 11:43 AM

Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 0.00 (9.84) min No Peak ng/ml 0.00 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 0.00 (9.84) min No Peak ng/ml 0.00 (Unknown)



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Created with Analyst Reporter
Printed: 10/11/2016 11:47 AM

Data File	LM37326.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 11:00:41 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

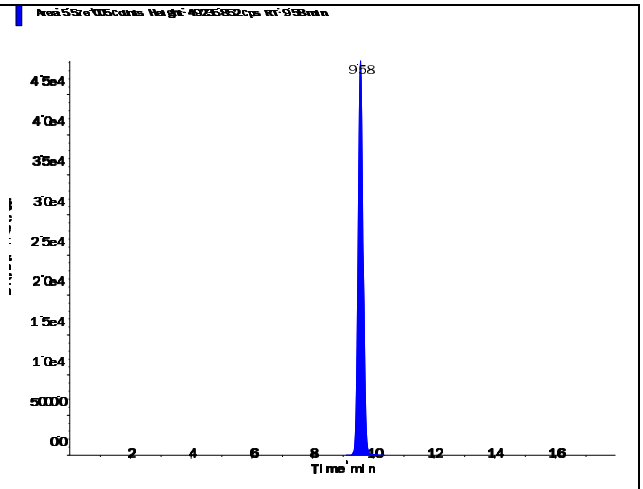
Sample Name	WG586942-06 CCB	**Injection Vial**	1.00
Data File	LM37326.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 11:00:41 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586942-06	**Dilution Factor**	1.00
Sample Comment	11.00	**Weight to Volume**	0.00

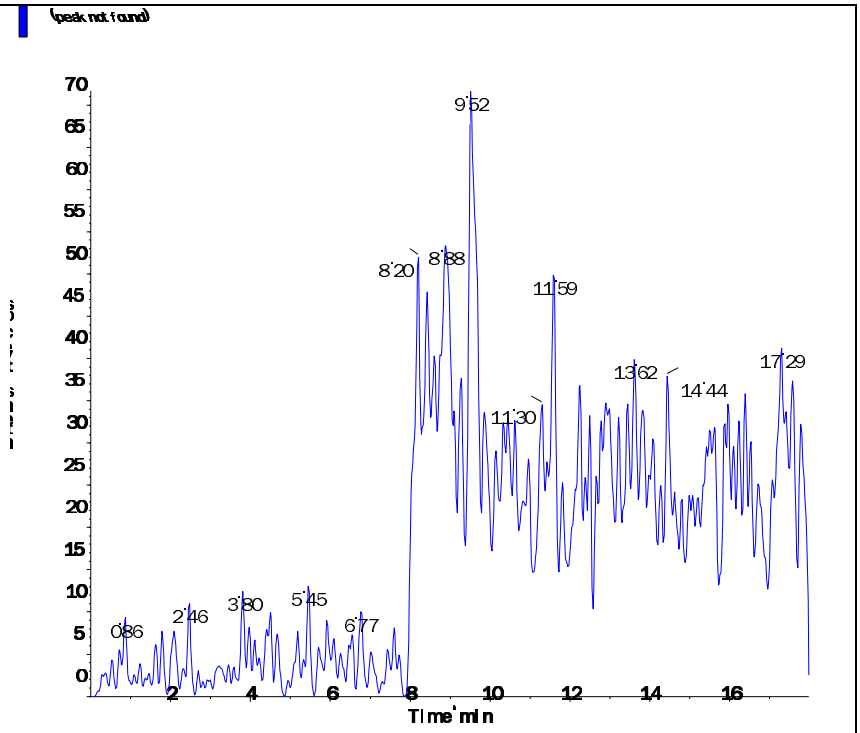
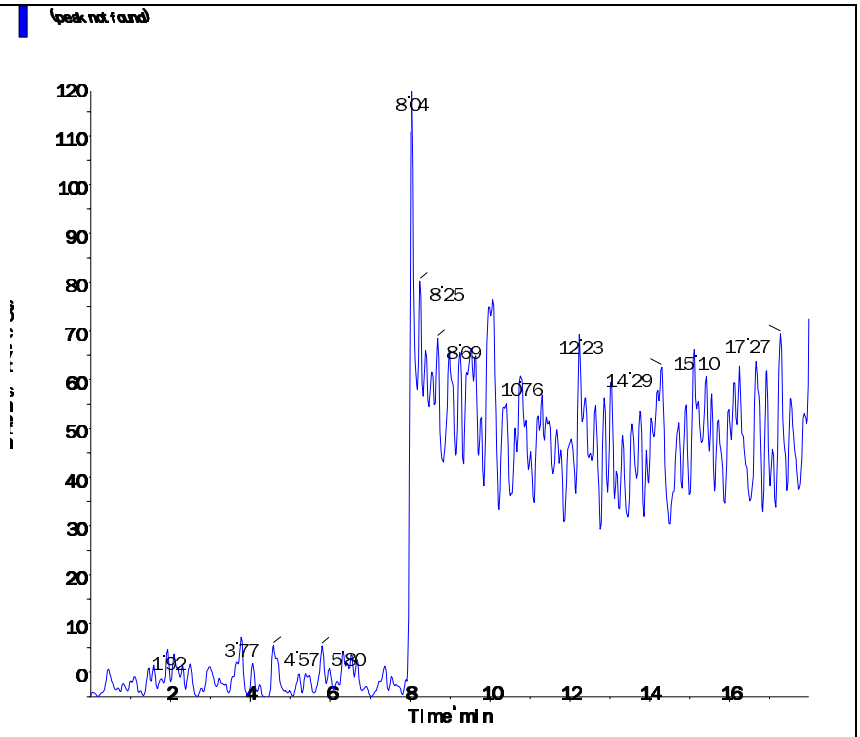
Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	5.570e+05	9.58	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	0.000e+00	0.00	N/A	No Peak
Perchlorate conf	0.000e+00	0.00	N/A	No Peak

O18LP (Internal Standard)

RT (Exp. RT): 9.58(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



Perchlorate (98.8/83.3 amu) RT (Exp. RT): 0.00 (9.84) min Calculated conc: No Peak ng/ml Area Ratio: 0.00 Sample Type: (Unknown)	
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): 0.00 (9.84) min Calculated conc: No Peak ng/ml Area Ratio: 0.00 Sample Type: (Unknown)	

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Created with Analyst Reporter
Printed: 10/11/2016 11:39 AM

Data File	LM37301.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 3:07:12 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

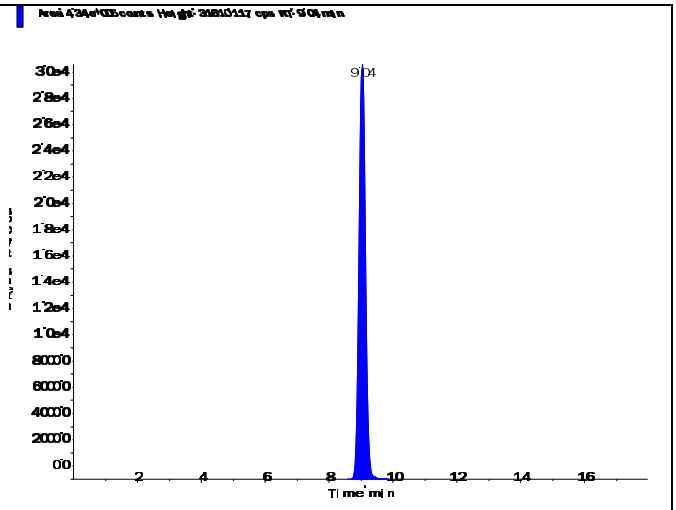
Sample Name	WG586928-01 MCT (0.2ug/L)	**Injection Vial**	4.00
Data File	LM37301.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 3:07:12 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-01	**Dilution Factor**	1.00
Sample Comment	1,1 STD78251	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.340e+05	9.04	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	2.820e+04	9.04	N/A	0.189
Perchlorate conf	8.880e+03	9.04	N/A	0.163

O18LP (Internal Standard)

RT (Exp. RT): 9.04(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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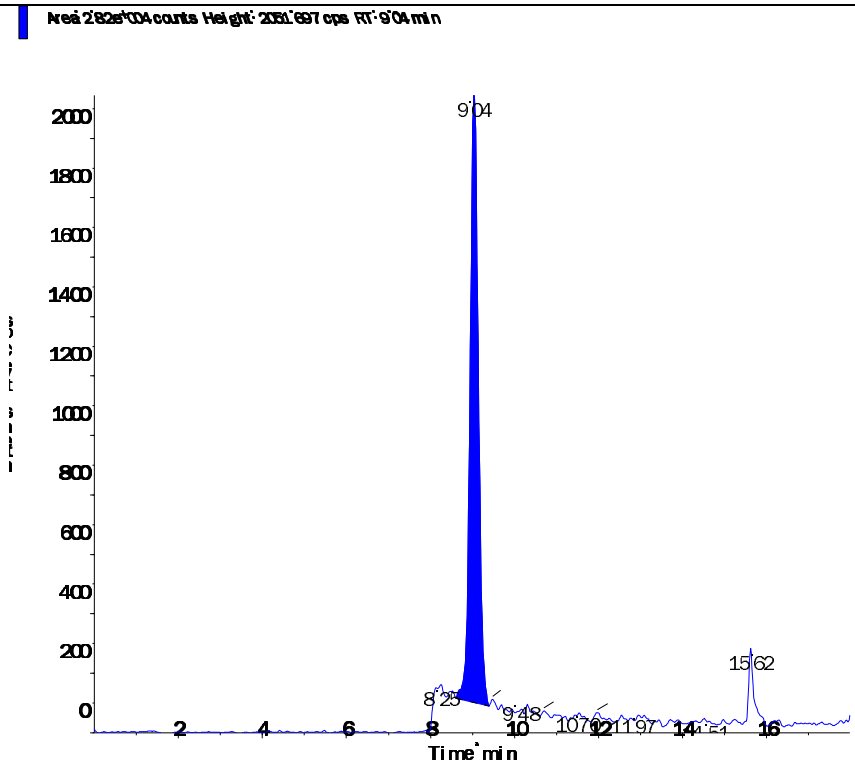
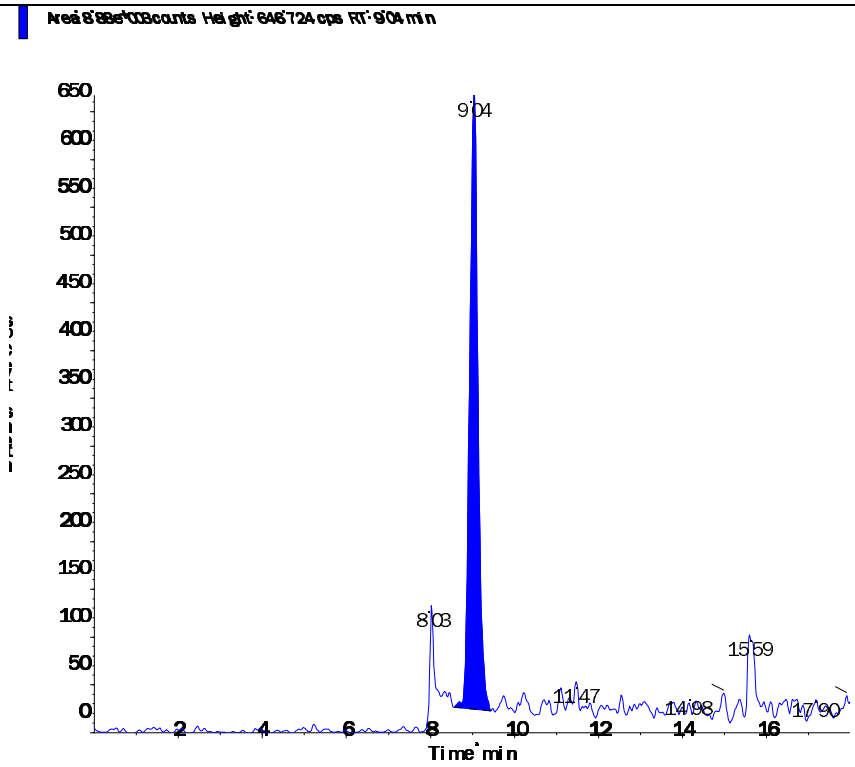
Created with Analyst Reporter
Printed: 10/11/2016 11:39 AM

Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	9.04 (9.84) min 0.189 ng/ml 0.065 (Unknown)



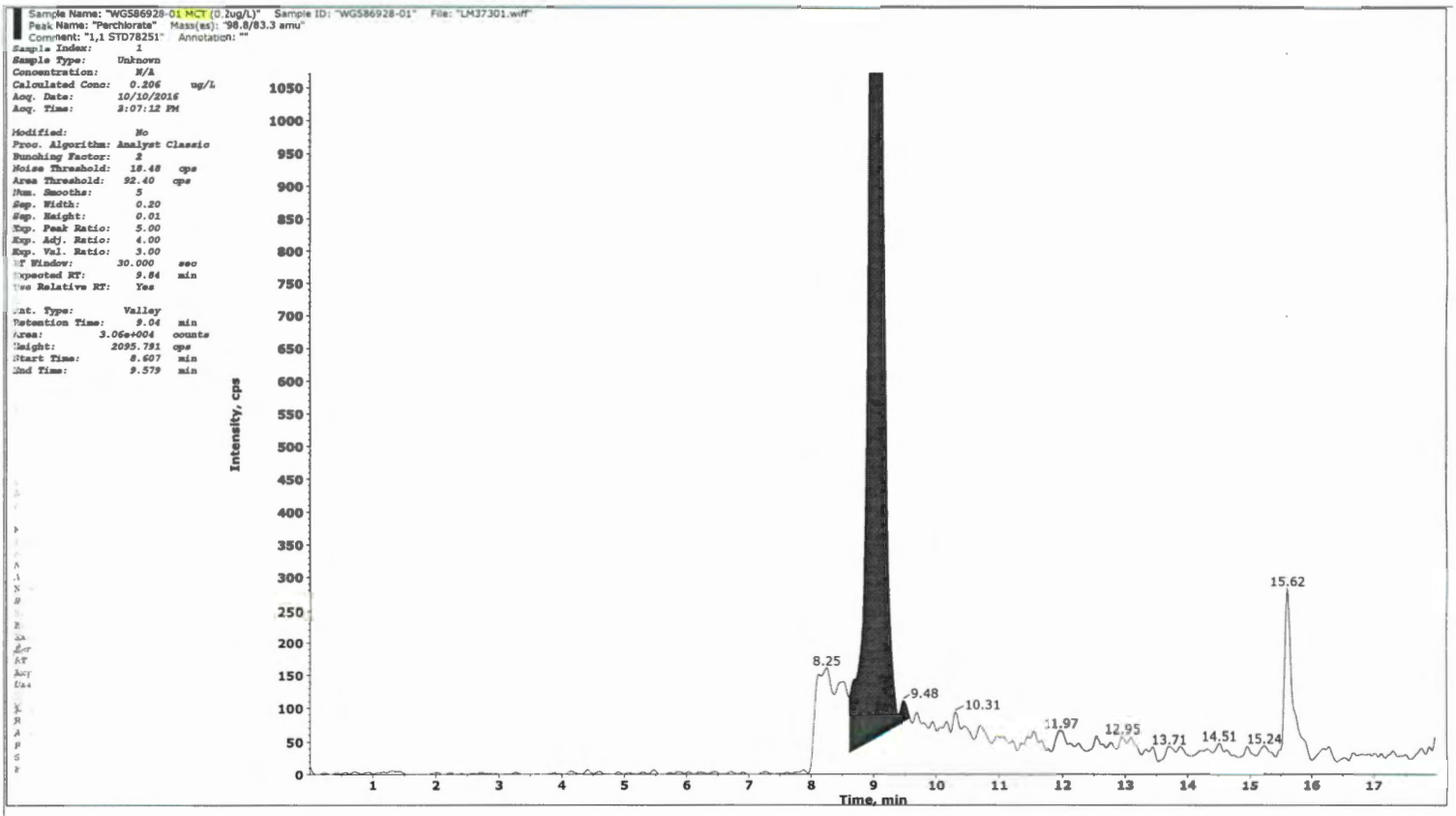
Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	9.04 (9.84) min 0.163 ng/ml 0.02 (Unknown)



Printing Time: 8:03:23 AM
Printing Date: Tuesday, October 11, 2016

Sample Name: "WG586928-01 MCT (0.2ug/L)" Sample ID: "WG586928-01" File: "LM37301.wiff"
Peak Name: "Perchlorate" Mass(es): "98.8/83.3 amu"
Comment: "1,1 STD78251" Annotation: ""

Sample Index:	1
Sample Type:	Unknown
Concentration:	N/A
Calculated Conc:	0.206 ug/L
Acq. Date:	10/10/2016
Acq. Time:	3:07:12 PM
Modified:	No
Proc. Algorithm:	Analyst Classic
Bunching Factor:	2
Noise Threshold:	18.48 cps
Area Threshold:	92.40 cps
Num. Smooths:	5
Sep. Width:	0.20
Sep. Height:	0.01
Exp. Peak Ratio:	5.00
Exp. Adj. Ratio:	4.00
Exp. Val. Ratio:	3.00
RT Window:	30.000 sec
Expected RT:	9.84 min
Use Relative RT:	Yes
Int. Type:	Valley
Retention Time:	9.04 min
Area:	3.06e+004 counts
Height:	2095.791 cps
Start Time:	8.607 min
End Time:	9.579 min

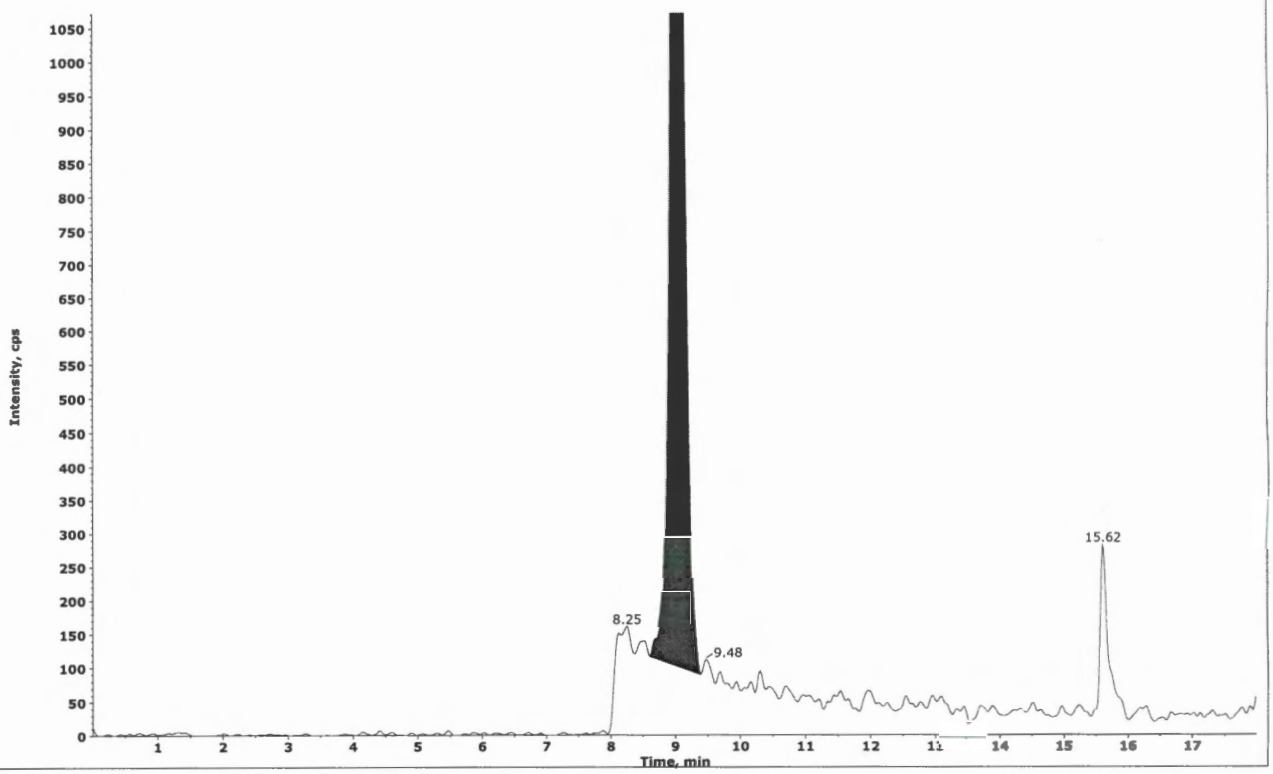


Collected by: N/A
Electronic Signature: no
Operator: lcms1

Printing Time: 8:13:13 AM
Printing Date: Tuesday, October 11, 2016

Sample Name: "WG586928-01 MCT (0.2ug/L)" Sample ID: "WG586928-01" File: "LM37301.wiff"
Peak Name: "Perchlorate" Mass(es): "98.8/83.3 amu"
Comment: "1,1 STD78251" Annotation: ""

Sample Index:	1
Sample Type:	Unknown
Concentration:	N/A
Calculated Conc:	0.188 ug/L
Acq. Date:	10/10/2016
Acq. Time:	3:07:12 PM
Modified:	Yes
Proc. Algorithm:	Analyst Classic
Smoothing Factor:	2
Noise Threshold:	18.48 cps
Area Threshold:	92.40 cps
Num. Smooths:	5
Exp. Width:	0.20
Exp. Height:	0.01
Exp. Peak Ratio:	5.00
Exp. Adj. Ratio:	4.00
Exp. Val. Ratio:	3.00
RT Window:	30.000 sec
Expected RT:	9.84 min
Use Relative RT:	Yes
Int. Type:	Manual
Retention Time:	9.04 min
Area:	2.82e+004 counts
Height:	2051.697 cps
Start Time:	8.607 min
End Time:	9.397 min



#4
JWR/10/11/16
mf 10/11/16

Collected by: N/A
Electronic Signature: no
Operator: lcms1

2.1.1.5 Raw QC Data

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Created with Analyst Reporter
Printed: 10/11/2016 11:39 AM

Data File	LM37302.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 3:26:08 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

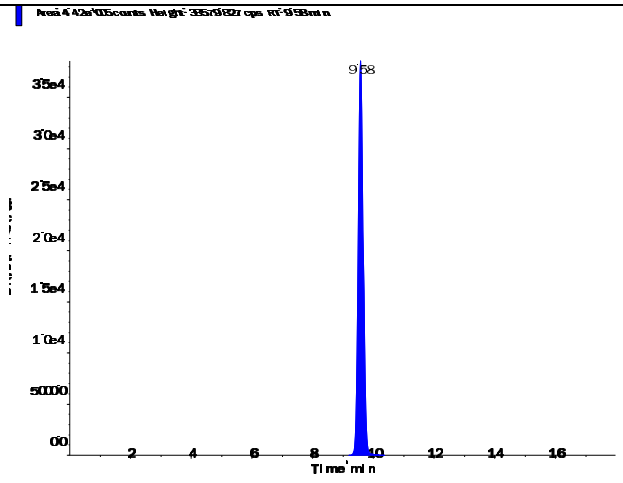
Sample Name	WG586928-02 BLANK	**Injection Vial**	5.00
Data File	LM37302.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 3:26:08 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-02	**Dilution Factor**	1.00
Sample Comment	11.00	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.420e+05	9.58	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	0.000e+00	0.00	N/A	No Peak
Perchlorate conf	0.000e+00	0.00	N/A	No Peak

O18LP (Internal Standard)

RT (Exp. RT): 9.58(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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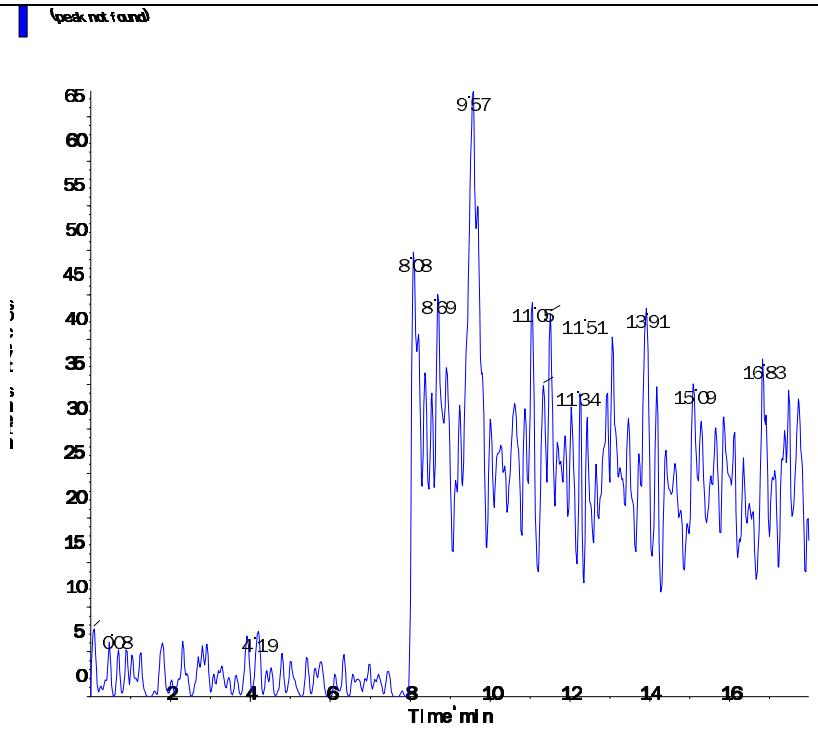
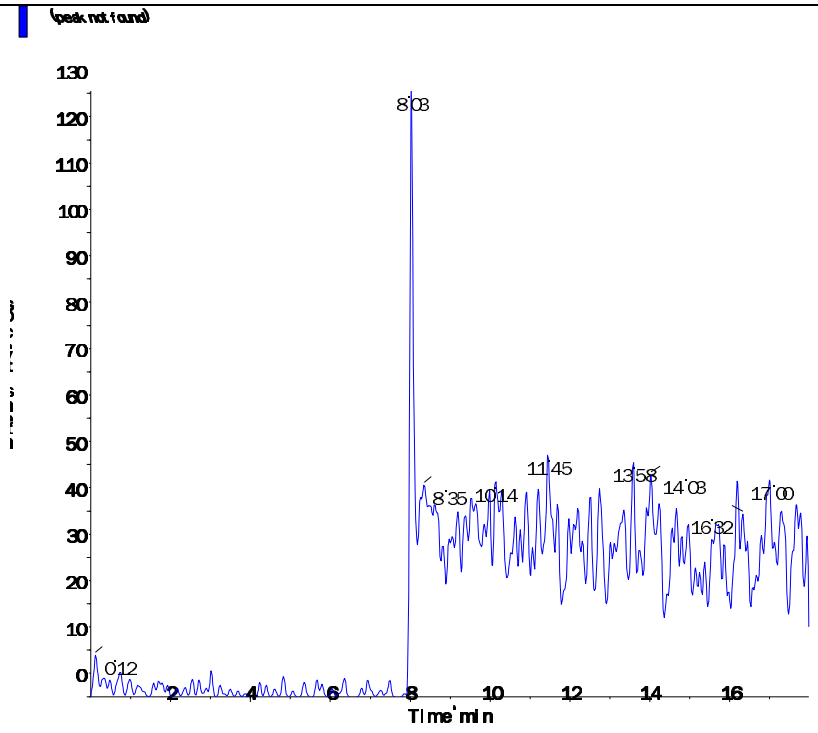
Created with Analyst Reporter
Printed: 10/11/2016 11:39 AM

Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 0.00 (9.84) min No Peak ng/ml 0.00 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	 0.00 (9.84) min No Peak ng/ml 0.00 (Unknown)



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Created with Analyst Reporter
Printed: 10/11/2016 11:39 AM

Data File	LM37303.wiff	**Result Table**	101016_JWR.rdb
Acquisition Date	10/10/2016 3:45:04 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Instrument Name**	API 4000
Project	Perchlorate\2009_07_22		

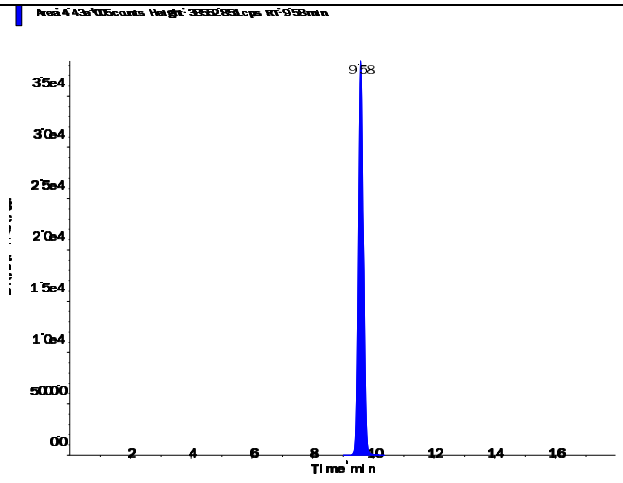
Sample Name	WG586928-03 LCS (0.2ug/L)	**Injection Vial**	6.00
Data File	LM37303.wiff	**Injection Volume**	10.00
Acquisition Date	10/10/2016 3:45:04 PM	**Algorithm Used**	Analyst Classic
Acquisition Method	062911.dam	**Sample Type**	Unknown
Instrument Name	API 4000	**Result Table**	101016_JWR.rdb
Sample ID	WG586928-03	**Dilution Factor**	1.00
Sample Comment	1,1 STD78251	**Weight to Volume**	0.00

Internal Standard	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
O18LP	4.430e+05	9.58	5.00	-

Target Analyte	Area (cps)	RT (min)	Target conc. (ug/L)	Calc. Conc. (ug/L)
Perchlorate	2.790e+04	9.60	N/A	0.183
Perchlorate conf	1.040e+04	9.58	N/A	0.19

O18LP (Internal Standard)

RT (Exp. RT): 9.58(9.84) min
Concentration: 5.00 ug/L
Sample Type: (Unknown)



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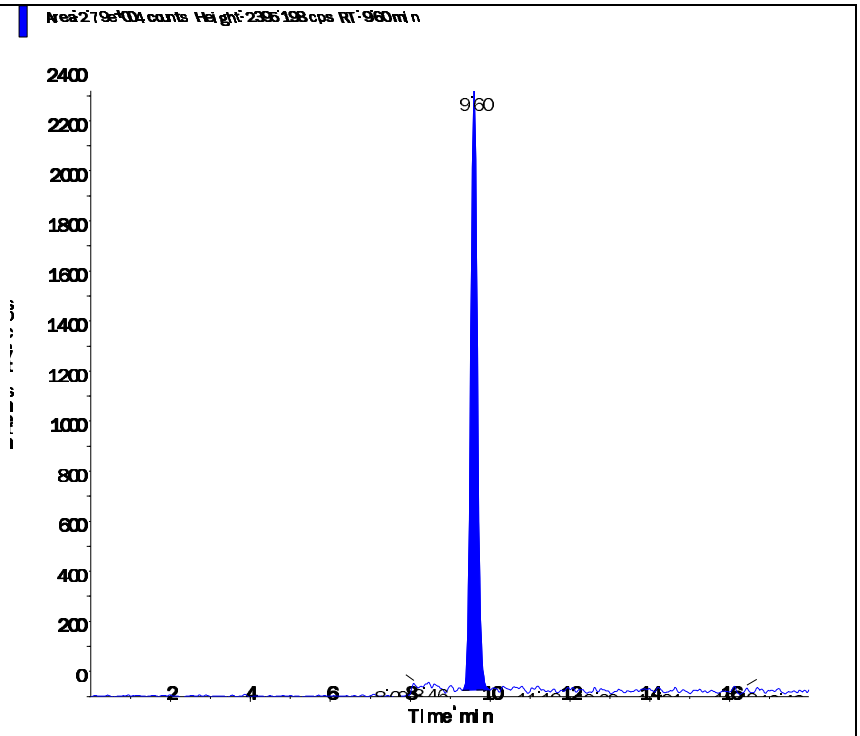
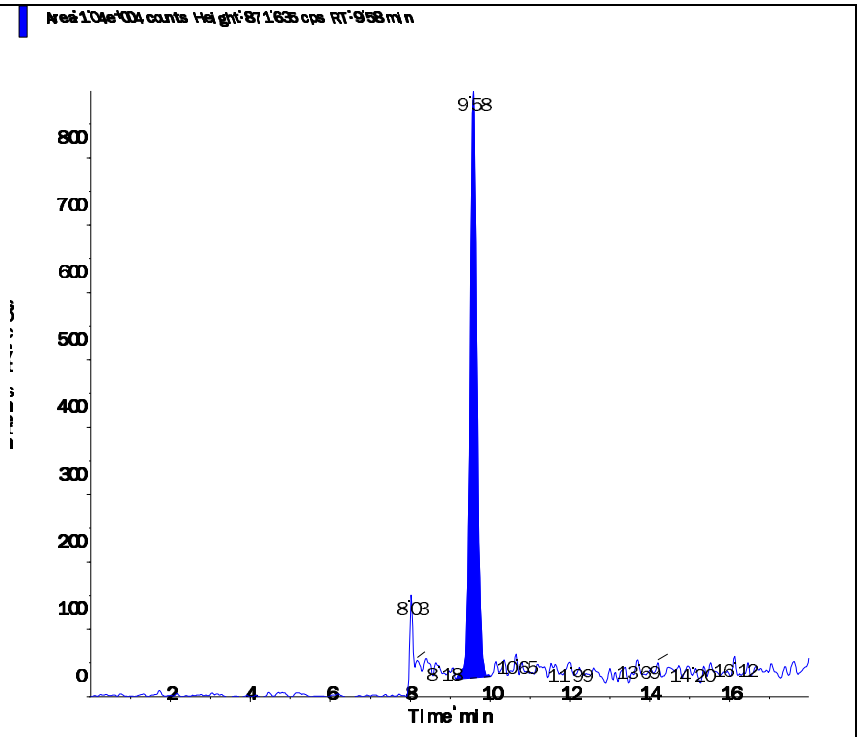
Created with Analyst Reporter
Printed: 10/11/2016 11:39 AM

Perchlorate (98.8/83.3 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	9.60 (9.84) min 0.183 ng/ml 0.063 (Unknown)



Perchlorate conf (100.8/85.2 amu) RT (Exp. RT): Calculated conc: Area Ratio: Sample Type:	9.58 (9.84) min 0.19 ng/ml 0.023 (Unknown)



3.0 Attachments

Microbac Laboratories Inc.
Ohio Valley Division Analyst List
October 13, 2016

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001 – BIO-CHEM TESTING WVDEP 220	002 – REIC Consultants, Inc. WVDEP 060
003 – Sturm Environmental	004 – MICROBAC PITTSBURGH
005 – ES LABORATORIES	006 – ALCOSAN LABORATORIES
007 – ALS LABORATORIES	008 – BENCHMARK LABORATORIES
010 – MICROBAC CHICAGOLAND	AC – AMBER R. CARMICHAEL
ADC – ANTHONY D. CANTER	ADG – APRIL D. GREENE
AED – ALLEN E. DAVIS	ALS – ADRIANE L. STEED
AMA – ALEXANDRA M. ALFRED	AWE – ANDREW W. ESSIG
AZH – AFTER HOURS	BJO – BRIAN J. OGDEN
BKT – BRENDAN TORRENCE	BLG – BRENDA L. GREENWALT
BNB – Brandi N. Bentley	BRG – BRENDA R. GREGORY
CAA – CASSIE A. AUGENSTEIN	CAF – CHERYL A. FLOWERS
CAS – Craig A. Smith	CEB – CHAD E. BARNES
CJQ – Cameron J. Quick	CLC – CHRYS L. CRAWFORD
CLS – CARA L. STRICKLER	CLW – CHARISSA L. WINTERS
CPD – CHAD P. DAVIS	CSH – CHRIS S. HILL
CV – Carl Volkman	DAK – DEAN A. KETELSEN
DCM – DAVID C. MERCKLE	DEV – DAVID E. VANDENBERG
DIH – DEANNA I. HESSON	DLB – DAVID L. BUMGARNER
DLP – DOROTHY L. PAYNE	DSM – DAVID S. MOSSOR
ECL – ERIC C. LAWSON	EMW – ERIC M. WILKEN
ENY – EMILY N. YOAK	ERP – ERIN R. PORTER
FJB – FRANCES J. BOLDEN	HDD – HANAH D. DAWKINS
JDH – JUSTIN D. HESSON	JDS – JARED D. SMITH
JKP – JACQUELINE K. PARSONS	JLD – JESSICA L. DELONG
JLL – JOHN L. LENT	JMW – JEANA M. WHITE
JTP – JOSHUA T. PEMBERTON	JWR – JOHN W. RICHARDS
JWS – JACK W. SHEAVES	JYH – JI Y. HU
KAK – KATHY A. KIRBY	KAT – KATHY A. TUCKER
KDD – Katelyn D. Daley	KDW – KATHRYN D. WELCH
KEB – KATIE E. BARNES	KHR – KIM H. RHODES
KKB – KERRI K. BUCK	KRA – KATHY R. ALBERTSON
KRB – KAELY R. BECKER	KRP – KATHY R. PARSONS
LJH – Lacey J. Hendershot	LKN – LINDA K. NEDEFF
LLS – LARRY L. STEPHENS	LSB – LESLIE S. BUCINA
MAP – MARLA A. PORTER	MBK – MORGAN B. KNOWLTON
MDA – MIKE D. ALBERTSON	MDC – MIKE D. COCHRAN
MES – MARY E. SCHILLING	MMB – MAREN M. BEERY
MRT – MICHELLE R. TAYLOR	MSW – MATT S. WILSON
NPH – Natalie P. Hart	PDM – PIERCE D. MORRIS
PIT – MICROBAC WARRENDALE	QX – QIN XU
RAH – ROY A. HALSTEAD	REK – BOB E. KYER
RLB – BOB BUCHANAN	RNP – RICK N. PETTY
SAV – SARAH A. VANDENBERG	SCB – SARAH C. BOGOLIN
SDC – SHALYN D. CONLEY	SLM – STEPHANIE L. MOSSBURG
SLP – SHERI L. PFALZGRAF	TB – TODD BOYLE
TGF – TIM G. FELTON	TMB – TIFFANY M. BAILEY
TMM – TAMMY M. MORRIS	VC – VICKI COLLIER
WJB – WILL J. BEASLEY	WTD – WADE T. DELONG
XXX – UNAVAILABLE OR SUBCONTRACT	

Microbac Laboratories Inc.
List of Valid Qualifiers
October 13, 2016

Qualkey: DOD

Qualifier	Description
*	Surrogate or spike compound out of range
+	Correlation coefficient for the MSA is less than 0.995
<	Result is less than the associated numerical value.
>	Greater than
>,H1	Result is greater than the associated numerical value. Sample analysis performed past holding time.
A	See the report narrative
B	The reported result is associated with a contaminated method blank.
B,H1	Analyte present in method blank. Sample analysis performed past holding time.
B1	Target analyte detected in method blank at or above the method reporting limit
B3	Target analyte detected in calibration blank at or above the method reporting limit
B4	The BOD unseeded dilution water blank exceeded 0.2 mg/L
C	Confirmed by GC/MS
CG	Confluent growth
CT1	Cooler temperature at sample reciept exceeded regulatory limit.
DL	Surrogate or spike compound was diluted out
E	Estimated concentration due to sample matrix interference
E,CT1	Estimated results. The cooler temperature at receipt exceeded regulatory guidelines for requested testing.
EDL	Elevated sample reporting limits, presence of non-target analytes
EMPC	Estimated Maximum Possible Concentration
F, S	Estimated result below quantitation limit; method of standard additions(MSA)
F,CT1	Estimated value; the analyte concentration was less than the RL/LOQ. The cooler temperature at receipt exceeded regula
FL	Free Liquid
FP1	Did not ignite.
H1	Sample analysis performed past holding time.
H1,CT1	Sample analysis performed past holding time. The cooler temperature at receipt exceeded regulatory guidelines for reque
I	Semiquantitative result (out of instrument calibration range)
J	Estimated concentration; sample matrix interference.
J	Estimated value ; the analyte concentration was greater than the highest standard
J	Estimated value ; the analyte concentration was less than the LOQ.
J	The reported result is an estimated value.
J,B	Analyte detected in both the method blank and sample above the MDL.
J,CT1	Estimated value ; the analyte concentration was less than the LOQ. Cooler temperature at sample reciept exceeded regu
J,H1	Estimated value ; the analyte concentration was less than the LOQ. Sample analysis performed past holding time.
J,H1	The reported result is an estimated value. Sample was analyzed past holding time.
J,P	Estimate; columns don't agree to within 40%
J,S	Estimated concentration; analyzed by method of standard addition (MSA)
JB	The reported result is an estimated value. The reported result is also associated with a contaminated method blank.
JQ	The reported result is an estimated value and one or more quality control criteria failed. See narrative.
L	Sample reporting limits elevated due to matrix interference
L1	The associated blank spike (LCS) recovery was above the laboratory acceptance limits.
L2	The associated blank spike (LCS) recovery was below the laboratory acceptance limits.
M	Matrix effect; the concentration is an estimate due to matrix effect.
N	Nontarget analyte; the analyte is a tentativlely identified compound (TIC) by GC/MS
NA	Not applicable
ND	Not detected at or above the reporting limit (RL)
ND, B	Not detected at or above the reporting limit (RL). Analyte present in method blank.
ND, CT1	Analyte was not detected. The concentration is below the reported LOD. The cooler temperature at receipt exceeded reg
ND, L	Not detected; sample reporting limit (RL) elevated due to interference
ND, S	Not detected; analyzed by method of standard addition (MSA)
ND,H1	Not detected; Sample analysis performed past holding time.
ND,H1,CT1	Not detected; Sample analysis performed past holding time. The cooler temperature at receipt exceeded regulatory guide
NF	Not found by library search
NFL	No free liquid
NI	Non-ignitable
NR	Analyte is not required to be analyzed
NS	Not spiked
P	Concentrations >40% difference between the two GC columns
Q	One or more quality control criteria failed. See narrative.
Q,H1	One or more quality control criteria failed. Sample analyzed past holding time. See narrative.
QNS	Quantity of sample not sufficient to perform analysis
RA	Reanalysis confirms reported results
RE	Reanalysis confirms sample matrix interference
S	Analyzed by method of standard addition (MSA)
SMI	Sample matrix interference on surrogate
SP	Reported results are for spike compounds only
T5	Laboratory not licensed for this parameter
TIC	Library Search Compound

Microbac Laboratories Inc.
List of Valid Qualifiers
October 13, 2016

Qualkey: DOD

TNTC	Too numerous to count
TNTC, B	Too numerous to count. Analyte present in method blank.
TNTC,CT1	Too numerous to count. The cooler temperature at receipt exceeded regulatory guidelines for requested testing.
TNTC,H1	Too numerous to count. Sample analysis performed past holding time.
U	Analyte was not detected. The concentration is below the reported LOD.
U,CT1	Analyte was not detected. The concentration is below the reported LOD. Cooler temperature at sample reciept exceeded
U,H1	Not detected; Sample analysis performed past holding time.
UJ	Undetected; the MDL and RL are estimated due to quality control discrepancies.
UQ	Undetected; the analyte was analyzed for, but not detected.
W	Post-digestion spike for furnace AA out of control limits
X	Exceeds regulatory limit
X, S	Exceeds regulatory limit; method of standard additions (MSA)
Z	Cannot be resolved from isomer - see below

AECOM

Chain of Custody Record

COC Number:

Laboratory:	Microbac POC: Stephanie Mossburg	Project Manager:	Debra Richmann
Address:	158 Starlite Drive	Phone/Fax Number:	210-296-2000
	Marietta, OH 45750	Sampler (print):	Scott Beesinger
Phone:	1-800-373-4071		
Client:	AECOM	Signature:	Scott Beesinger
Address:	112 East Pecan Ste. 400		
	San Antonio, TX 78205		
Turn Around Time:	STANDARD	pH:	
Project Name/Location:	Longhorn		
Project Number:	60256135.0006EA 001-003 LUC5 FL		

Mail to: Linda Raabe, 112 East Pecan STE. 400, San Antonio, TX 78205, 210-296-2000

Fed Ex Airbill No:

Program:

ERPIMS REQUIRED FIELDS

Site Name	Sample ID/Location ID	SBD	SED	Date	Time	Comp	Grab	Matrix	Number of Containers	Perchlorate	SA CODE	Cooler ID	LOT CONTROL NUMBERS ABLOT	EBLOT	TBLOT
SITE 001	27WW01-092816			9/28/16	0820		X	W	1	X					
	27WW01MS-092816			9/28/16	0820		X	W	1	X					
	27WW01MSD-092816			9/28/16	0820		X	W	1	X					
	27WW03-092816			9/28/16	0920		X	W	1	X					
	132-092816			9/28/16	1020		X	W	1	X					
	132FD-092816			9/28/16	1020		X	W	1	X					
	131-092816			9/28/16	1115		X	W	1	X					
	27WW02-092816			9/28/16	1325		X	W	1	X					
	27WW04-092816			9/28/16	1425		X	W	1	X					

Comments: STANDARD TAT

Relinquished by: (Signature) Scott Beesinger	Date 9/29/16	Time 1500	Received by: (Signature)		Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Receiv (Signa		Time	Remarks:

Microbac OVD
Received: 09/30/2016 10:11
By: BRENDA GREGORY
221000091481
Brenda Gregory

ger, Pink QA/QC Manager

•Homogenize all composite samples prior to analysis

Microbac Laboratories Inc.

Internal Chain of Custody Report

Login: L16091387
Account: 2551
Project: 2551.096
Samples: 9
Due Date: 11-OCT-2016

Samplenum	Container ID	Products
L16091387-01	808262	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

Samplenum	Container ID	Products
L16091387-02	808263	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

Samplenum	Container ID	Products
L16091387-03	808264	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

Samplenum	Container ID	Products
L16091387-04	808265	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

A1 - Sample Archive (COLD)
A2 - Sample Archive (AMBIENT)
F1 - Volatiles Freezer in Login
V1 - Volatiles Refrigerator in Login
W1 - Walkin Cooler in Login

Microbac Laboratories Inc.

Internal Chain of Custody Report

Login: L16091387
Account: 2551
Project: 2551.096
Samples: 9
Due Date: 11-OCT-2016

Samplenum	Container ID	Products
L16091387-05	808266	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

Samplenum	Container ID	Products
L16091387-06	808267	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

Samplenum	Container ID	Products
L16091387-07	808268	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

Samplenum	Container ID	Products
L16091387-08	808269	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

A1 - Sample Archive (COLD)
A2 - Sample Archive (AMBIENT)
F1 - Volatiles Freezer in Login
V1 - Volatiles Refrigerator in Login
W1 - Walkin Cooler in Login

Microbac Laboratories Inc.

Internal Chain of Custody Report

Login: L16091387
Account: 2551
Project: 2551.096
Samples: 9
Due Date: 11-OCT-2016

Samplenum	Container ID	Products
L16091387-09	808270	6850

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish	pH
1	LOGIN	COOLER	W1	30-SEP-2016 14:21	CLS		
2	ANALYZ	W1	SEM	07-OCT-2016 08:40	JWR	BRG	
3	STORE	SEM	A1	12-OCT-2016 07:34	AZH	JWR	

A1 - Sample Archive (COLD)
A2 - Sample Archive (AMBIENT)
F1 - Volatiles Freezer in Login
V1 - Volatiles Refrigerator in Login
W1 - Walkin Cooler in Login

NELAP Addendum - January 4, 2016

Non-NELAP LIMS Product and Description

The following is a list of those tests that are not included in the Microbac – OVD NELAP Scope of Accreditation:

Heat of Combustion (BTU)
Total Halide by Bomb Combustion (TX)
Particle Sizing - 200 Mesh (PS200)
Specific Gravity/Density (SPGRAV)
Total Residual Chlorine (CL-TRL)
Total Volatile Solids (all forms) (TVS)
Total Coliform Bacteria (all methods)
Fecal Coliform Bacteria (all methods)
Sulfite (SO3)
Propionaldehyde (HPLC-UV)

SOLID AND HAZARDOUS CHEMICALS
Nitrogen, Ammonia by Method 350.1
Chromium, Hexavalent, Leachable by SM3500 Cr-B 2009
Phenolics, Total by Method 420.1
ASTM D3987-06

NELAP Accreditation by Laboratory SOP

NONPOTABLE WATER

OVD HPLC02/HPLC-UV

Nitroglycerin
Acetic acid
Butyric acid
Lactic acid
Propionic acid
Pyruvic acid

OVD MSS01/GC-MS

1,4-Phenylenediamine
1-Methylnaphthalene
1,4-Dioxane
Atrazine
Benzaldehyde
Biphenyl
Caprolactam
Hexamethylphosphoramide (HMPA)
Pentachlorobenzene
Pentachloroethane

NELAP Accreditation by Laboratory SOP

NONPOTABLE WATER

OVD MSV01/GC-MS

1, 1, 2-Trichloro-1,2,2-trifluoroethane
1,3-Butadiene
Cyclohexane
Cyclohexanone
Dimethyl disulfide
Dimethylsulfide
Ethyl-t-butylether (ETBE)
Isoprene
Methylacetate
Methylcyclohexane
T-amylmethylether (TAME)
Tetrahydrofuran (THF)

OVD HPLC07/HPLC-MS-MS

Hexamethylphosphoramide (XMPA-LCMS)

OVD HPLC12/HPLC/UV

Acetate
Formate

OVD RSK01/GC-FID

Acetylene
Propane

OVD K9305/ISE

Fluoroborate

SOLID AND HAZARDOUS CHEMICALS

OVD MSS0I/GC-MS

1-Methylnaphthalene
Benzaldehyde
Biphenyl
Caprolactam
Pentachloroethane

NELAP Accreditation by Laboratory SOP

SOLID AND HAZARDOUS CHEMICALS

OVD MSV0I/GC-MS

1.3-Butadiene
Cyclohexane
Cyclohexanone
Dimethyl disulfide
Dimethylsulfide
Ethyl-t-butylether (ETBE)
Isoprene
Methylacetate
Methylcyclohexane
n-Hexane
T-amylmethylether (TAME)

NOVEMBER 2017 LABORATORY ANALYTICAL REPORT

10450 Stancliff Rd. Suite 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887
www.alsglobal.com

WorkOrder: HS17111261

LHAAP/Site 001

Bhate Environmental Associates, Inc.

Marcia Olive
445 Union Blvd Ste 129
Lakewood CO 80228

12-Dec-2017

10450 Stancliff Rd. Suite 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887

December 12, 2017

Marcia Olive
Bhate Environmental Associates, Inc.
445 Union Blvd Ste 129
Lakewood, CO 80228

Work Order: **HS17111261**

Laboratory Results for: **LHAAP/Site 001**

Dear Marcia,

ALS Environmental received 7 sample(s) on Nov 22, 2017 for the analysis presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested. Results are expressed as "as received" unless otherwise noted.

QC sample results for this data met EPA or laboratory specifications except as noted in the Case Narrative or as noted with qualifiers in the QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained by ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

If you have any questions regarding this report, please feel free to call me.

Sincerely,

Sonia West

Generated By: Jumoke.Lawal
Sonia West
Project Manager

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Work Order: HS17111261

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS17111261-01	27WW02-112017	Groundwater		20-Nov-2017 13:40	22-Nov-2017 10:40	☐
HS17111261-02	27WW04-112017	Groundwater		20-Nov-2017 14:40	22-Nov-2017 10:40	☐
HS17111261-03	131-112117	Groundwater		21-Nov-2017 08:35	22-Nov-2017 10:40	☐
HS17111261-04	132-112117	Groundwater		21-Nov-2017 09:30	22-Nov-2017 10:40	☐
HS17111261-05	27WW03-112117	Groundwater		21-Nov-2017 10:35	22-Nov-2017 10:40	☐
HS17111261-06	27WW01-112117	Groundwater		21-Nov-2017 11:30	22-Nov-2017 10:40	☐
HS17111261-07	27WW01-112117-a	Groundwater		21-Nov-2017 11:30	22-Nov-2017 10:40	☐

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Work Order: HS17111261

CASE NARRATIVE

Work Order Comments

• The analyses for Perchlorate were subcontracted to ALS Environmental in Salt Lake City, UT. Final Report attached.

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Sample ID: 27WW02-112017
Collection Date: 20-Nov-2017 13:40

ANALYTICAL REPORT
WorkOrder:HS17111261
Lab ID:HS17111261-01
Matrix:Groundwater

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	12-Dec-2017 14:08

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Sample ID: 27WW04-112017
Collection Date: 20-Nov-2017 14:40

ANALYTICAL REPORT
WorkOrder:HS17111261
Lab ID:HS17111261-02
Matrix:Groundwater

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	12-Dec-2017 14:08

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Sample ID: 131-112117
Collection Date: 21-Nov-2017 08:35

ANALYTICAL REPORT
WorkOrder:HS17111261
Lab ID:HS17111261-03
Matrix:Groundwater

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	12-Dec-2017 14:08

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Sample ID: 132-112117
Collection Date: 21-Nov-2017 09:30

ANALYTICAL REPORT
WorkOrder:HS17111261
Lab ID:HS17111261-04
Matrix:Groundwater

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	12-Dec-2017 14:08

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Sample ID: 27WW03-112117
Collection Date: 21-Nov-2017 10:35

ANALYTICAL REPORT
WorkOrder:HS17111261
Lab ID:HS17111261-05
Matrix:Groundwater

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	12-Dec-2017 14:08

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Sample ID: 27WW01-112117
Collection Date: 21-Nov-2017 11:30

ANALYTICAL REPORT
WorkOrder:HS17111261
Lab ID:HS17111261-06
Matrix:Groundwater

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	12-Dec-2017 14:08

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
Sample ID: 27WW01-112117-a
Collection Date: 21-Nov-2017 11:30

ANALYTICAL REPORT
WorkOrder:HS17111261
Lab ID:HS17111261-07
Matrix:Groundwater

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	12-Dec-2017 14:08

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
WorkOrder: HS17111261

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R307042	**Test Name :** SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)	**Matrix:** Groundwater				
HS17111261-01	27WW02-112017	20 Nov 2017 13:40			12 Dec 2017 14:08	1
HS17111261-02	27WW04-112017	20 Nov 2017 14:40			12 Dec 2017 14:08	1
HS17111261-03	131-112117	21 Nov 2017 08:35			12 Dec 2017 14:08	1
HS17111261-04	132-112117	21 Nov 2017 09:30			12 Dec 2017 14:08	1
HS17111261-05	27WW03-112117	21 Nov 2017 10:35			12 Dec 2017 14:08	1
HS17111261-06	27WW01-112117	21 Nov 2017 11:30			12 Dec 2017 14:08	1
HS17111261-07	27WW01-112117-a	21 Nov 2017 11:30			12 Dec 2017 14:08	1

ALS Group USA, Corp Date: 12-Dec-17

Client: Bhate Environmental Associates, Inc.
Project: LHAAP/Site 001
WorkOrder: **HS17111261**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL/SDL

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitaion Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

CERTIFICATIONS,ACCREDITATIONS & LICENSES

Agency	Number	Expire Date
Arkansas	17-027-0	27-Mar-2018
California	2919 2016-2018	31-Jul-2018
Illinois	004112	09-May-2018
Kentucky	123043	30-Apr-2018
Louisiana	03087 2017-2017	30-Jun-2018
North Carolina	624-2017	31-Dec-2017
North Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018

ALS Group USA, Corp Date: 12-Dec-17

Sample Receipt Checklist

Client Name: Bhate Environmental
Work Order: HS17111261
Date/Time Received: **22-Nov-2017 10:40**
Received by: **JRM**

Checklist completed by: *Jared R. Makan* eSignature 27-Nov-2017 Date
Reviewed by: *Sonia West* eSignature 28-Nov-2017 Date

Matrices: **Water**
Carrier name: **UPS**

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
TX1005 solids received in hermetically sealed vials?	Yes ☐	No ☐	N/A ☑
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Temperature(s)/Thermometer(s):	2.1c/2.4c UC/C	IR11	
Cooler(s)/Kit(s):	Blue		
Date/Time sample(s) sent to storage:	11/22/2017 18:00		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑
pH adjusted?	Yes ☐	No ☐	N/A ☑
pH adjusted by:			

Login Notes: Samples refrigerated prior to login.

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

bhate ENVIRONMENTAL ASSOCIATES, INC.

1608 13th Avenue South, Suite 300
Birmingham Alabama 35205
Tel: 205-918-4000
Fax: 205-918-4050

Chain of Custody and Analytical Request

Project/Phase No: NWO1312.0150

COC Number(1): _____

LIMS Number: _____

Facility/Base I.D.: LHAAP

Project/Site Name: LHAAP / Site 001

Client Name:

Collected by: Scott Beesinger

Sample Analysis Requested [5] | Quality Assurance Samples [6]

Field Sample ID (30 Characters Max)	ERPIMS LOCID (15 Characters Max)	Date Collected (dd-mmm-yyyy)	Time Collected (Military) (hhmm)	Sample Depth (beginning - ending)	SA Code [2]	Sample Number [3]	Sample Matrix [4]	Number of containers	Perchlorate	Ambient Blank Lot Control Number	Equipment Blank Lot Control Number	Trip Blank Lot Control Number	Cooler ID
27wwo2_112017		20 NOV 2017	1340	-			WG	1	X				
27wwo4_112017		20 NOV 2017	1440	-			WG	1	X				
27wwo4_112017_MS		20 NOV 2017	1440	-			WG	1	X				
27wwo4_112017_SD		20 NOV 2017	1440				WG	1	X				
131_112117		21 NOV 2017	0835				WG	1	X				
132_112117		21 NOV 2017	0930	-			WG	1	X				
27wwo3_112117		21 NOV 2017	1035	-			WG	1	X				
27wwo1_112117		21 NOV 2017	1130	-			WG	1	X				
27wwo1_112117_a		21 NOV 2017	1130	-			WG	1	X				
				-									
				-									

HS17111261

Bhate Environmental Associates, Inc.
LHAAP/Site 001

COMMENTS: _____

Custody Transfers Prior to Receipt by Laboratory

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1. Scott Beesinger	11/21/17	1415	1. TM	11/22/17	10:20
2.			2.		
3.			3.		

Sample Delivery Details / Laboratory Receipt

Delivered Directly to Lab: _____ Shipped No.:

_____ Method of Shipment: _____

_____ Fed Ex _____ Airbill Number:

_____ Analytical Lab: ALS 10450 Stancliff Rd. Suite 210 Houston, TX 77099 (281) 530-5656

ATTN: SONIA WEST Lab Recipient: Delivery Date/Time:

1.) Chain of Custody Number = date collected + custody number (e.g. 09-02-1999-01)

2.) Sample Type (SA) Codes: N = Normal Sample, TB = Trip Blank (-c) Sample, FD = Field Duplicate (-a) Samples, FR = Field Replicate (-b) Samples, EB = Equipment Blank (-d) Samples, MS = Matrix Spike, SD = Matrix Spike Duplicate, AB = Ambient Blank (-e)

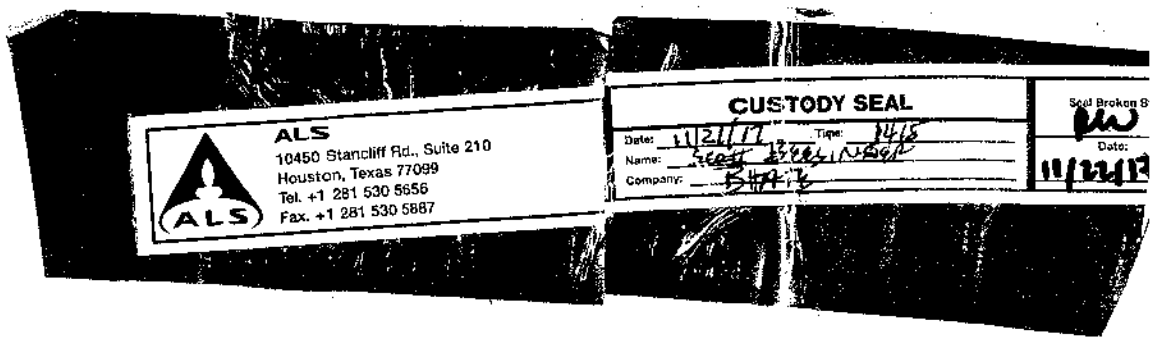
3.) Sample Number: Unique sample number collected from a particular location per day. (e.g. Groundwater sample collected from MW-1 on 10/10/99 = 01, if sampled again on 10/10/99 = 02, etc.)

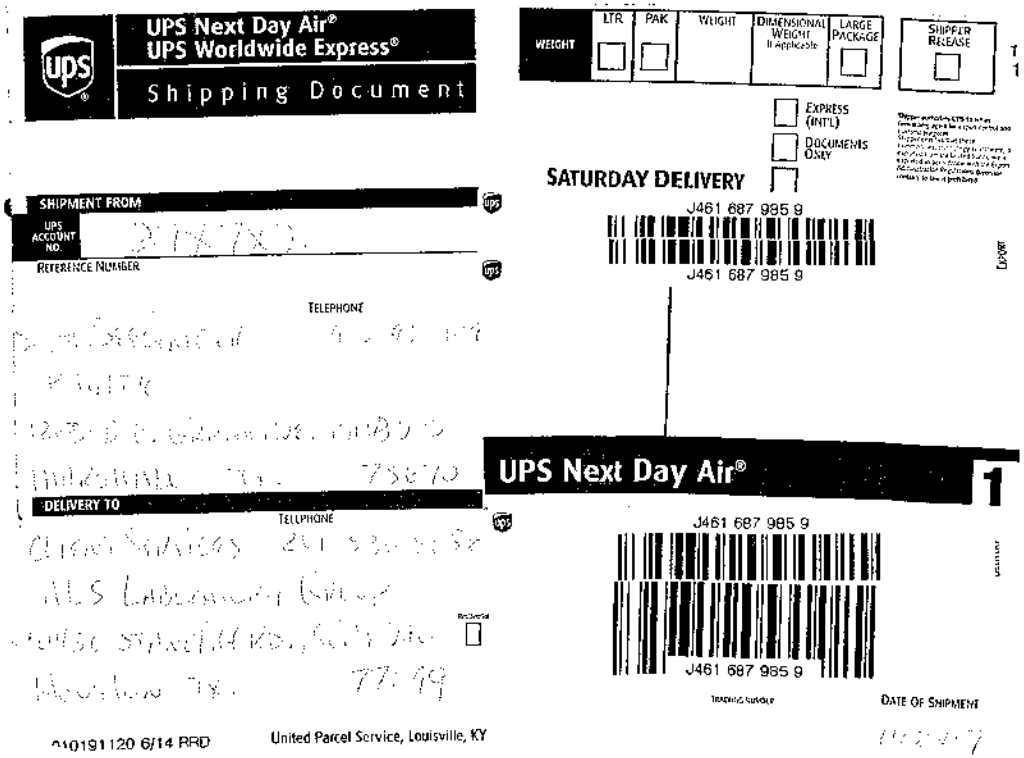
4.) Matrix Codes: GS = Soil Gas, WG = Groundwater, WS = Surface Water, SO = Soil, SE = Sediment, SL = Sludge, SS = Surface Soil Samples, WQ = Aqueous Blank Samples (trip, equipment, ambient, etc), SQ = Soil Blanks

5.) Sample Analysis Requested: Analytical method requested and number of containers provided for each.

6.) Quality assurance samples are assigned by date (ddmmyy) and the sample number associated with the sample (01, 02, etc) (e.g. Equipment blank collected in association with MW-1 on 10/10/99 will be designated 10109901 in the Equipment Blank Lot Control

Cooler Intact
Temp 2.1 CF 0.2


ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887
CUSTODY SEAL
Date: 11/24/17 Time: 1415
Name:
Company:
Seal Broken
Date: 11/24/17


UPS Next Day Air®
UPS Worldwide Express®
Shipping Document
WEIGHT
LTR
PAK
WEIGHT
DIMENSIONAL WEIGHT If Applicable
LARGE PACKAGE
SHIPPER RELEASE
EXPRESS (INT'L)
DOCUMENTS ONLY
SATURDAY DELIVERY
J461 687 985 9
SHIPMENT FROM
UPS ACCOUNT NO.
REFERENCE NUMBER
TELEPHONE
DELIVERY TO
TELEPHONE
NLS Laboratories
UPS Next Day Air®
1
J461 687 985 9
DATE OF SHIPMENT
United Parcel Service, Louisville, KY

Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1733231; 1733874

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2006 (204446)

General Set Information: There were eight field samples in these Work Orders. The samples were analyzed for perchlorate.

Method Summary: Each sample was prepared as noted below and analyzed using an Agilent 1100 LC/MSD system in select ion monitoring (SIM) mode at m/z 83 and 85, which corresponds to the loss of one oxygen atom from the perchlorate molecule. ChemStation software was used for instrument control and data analysis. The ion ratio of m/z 83 to 85 was used to positively identify the response peak as perchlorate. Quantitation was performed using the m/z 83 peak area. An internal standard (ISTD) of ^{18}O labeled perchlorate was added to each sample to establish the perchlorate peak retention time and used in quantitation.

Sample Preparation: A 10.0mL aliquot of each sample was transferred into a 15-mL centrifuge tube. 50µL of an ^{18}O labeled perchlorate solution was added to each sample as an internal standard. The samples were then capped, vortexed, and filtered into autosampler vial using Phenex PES membrane 0.45µm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: NA

Method QC data: The method blank (LMB 577683) was less than 1/2 the CRDL. The recovery for the LCS (577684) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on samples 1733231003/04 (Client ID: 27WW04-112017). The MS/MSD percent recoveries and relative percent difference (RPD) were within the performance limits.

Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): None were required for this set.

Sample Calculation: Samples were reported in µg/L. Results were calculated in µg/L by the equation (A)x(B),

where: A = Analyte concentration from the standard curve (µg/L)
B = Dilution performed at time of analysis

Miscellaneous Comments: These samples were analyzed in accordance with the requirements found in the DOD QSM Version 5.1. Manual Integrations were performed for some of the Initial Calibration analyses (datafiles: 28NOVP01/02) along with datafiles 07DECP03/17.

Thomas Bosch December 11, 2017
Date

ANALYTICAL REPORT

Report Date: December 12, 2017

Sonia West
ALS Environmental
10450 Stancliff Rd.
Suite 210
Houston, TX 77099

Phone: (281) 530-5656

E-mail: Sonia.West@alsglobal.com

Workorder: **34-1733231**
Project ID: HS17111261 112017
Purchase Order: HS17111261
Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
27WW02-112017	1733231001	11/20/17	11/28/17	
27WW04-112017	1733231002	11/20/17	11/28/17	
131-112117	1733231005	11/21/17	11/28/17	
132-112117	1733231006	11/21/17	11/28/17	
27WW03-112117	1733231007	11/21/17	11/28/17	
27WW01-112117	1733231008	11/21/17	11/28/17	
27WW01-112117-a	1733231009	11/21/17	11/28/17	

Client QC ID *	Lab ID	Collect Date	Receive Date	Sampling Site
27WW04-112017MS	1733231003	11/20/17	11/28/17	
27WW04-112017MSD	1733231004	11/20/17	11/28/17	

***Client QC is reported as part of the Quality Control results report, if requested.**

ANALYTICAL REPORT

Workorder: 34-1733231
Client: ALS Environmental (Houston)
Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: **27WW02-112017** | Sampling Site: NA | Collected: 11/20/2017
Lab ID: 1733231001 | Media: 250 mL Nalgene | Received: 11/28/2017
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2006 (HBN: 204446) | **Percent Solid:** NA
Analyzed: 12/07/2017 10:19 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **27WW04-112017** | Sampling Site: NA | Collected: 11/20/2017
Lab ID: 1733231002 | Media: 250 mL Nalgene | Received: 11/28/2017
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2006 (HBN: 204446) | **Percent Solid:** NA
Analyzed: 12/07/2017 10:40 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **131-112117** | Sampling Site: NA | Collected: 11/21/2017
Lab ID: 1733231005 | Media: 250 mL Nalgene | Received: 11/28/2017
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2006 (HBN: 204446) | **Percent Solid:** NA
Analyzed: 12/07/2017 11:38 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **132-112117** | Sampling Site: NA | Collected: 11/21/2017
Lab ID: 1733231006 | Media: 250 mL Nalgene | Received: 11/28/2017
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2006 (HBN: 204446) | **Percent Solid:** NA
Analyzed: 12/07/2017 11:57 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

ANALYTICAL REPORT

Workorder: 34-1733231
Client: ALS Environmental (Houston)
Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: **27WW03-112117** | Sampling Site: NA | Collected: 11/21/2017
Lab ID: 1733231007 | Media: 250 mL Nalgene | Received: 11/28/2017
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2006 (HBN: 204446) | **Percent Solid:** NA
Analyzed: 12/07/2017 12:16 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **27WW01-112117** | Sampling Site: NA | Collected: 11/21/2017
Lab ID: 1733231008 | Media: 250 mL Nalgene | Received: 11/28/2017
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2006 (HBN: 204446) | **Percent Solid:** NA
Analyzed: 12/07/2017 12:35 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **27WW01-112117-a** | Sampling Site: NA | Collected: 11/21/2017
Lab ID: 1733231009 | Media: 250 mL Nalgene | Received: 11/28/2017
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2006 (HBN: 204446) | **Percent Solid:** NA
Analyzed: 12/07/2017 12:54 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
EPA 6850, DoD QSM	/S/ Thomas Bosch 12/07/2017 14:51	/S/ Stephen Brose 12/12/2017 08:05

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Workorder: 34-1733231
Client: ALS Environmental (Houston)
Project Manager: Kevin W. Griffiths

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	ANAB (DoD ELAP)	ADE-1420	http://www.anab.org/accredited-organizations/
	Utah (NELAC)	DATA1	http://health.utah.gov/lab/labimp/
	Nevada	UT00009	http://ndep.nv.gov/bsdw/labservice.htm
	Oklahoma	UT00009	http://www.deq.state.ok.us/CSDnew/
	Iowa	IA# 376	http://www.iowadnr.gov/InsideDNR/RegulatoryWater.aspx
	Texas (TNI)	T104704456-11-1	http://www.tceq.texas.gov/field/qa/lab_accred_certif.html
	Washington	C596-16	http://www.ecy.wa.gov/programs/eap/labs/index.html
	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
Industrial Hygiene	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
	Washington	C596-16	http://www.ecy.wa.gov/programs/eap/labs/index.html
Lead Testing:			
CPSC	ANAB (ISO 17025, CPSC)	ADE-1420	http://www.anab.org/accredited-organizations/
Soil, Dust, Paint ,Air	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
Dietary Supplements	ACLASS (ISO 17025)	ADE-1420	http://www.aclasscorp.com

ANALYTICAL REPORT

Workorder: 34-1733231
Client: ALS Environmental (Houston)
Project Manager: Kevin W. Griffiths

Result Symbol Definitions

MDL = Method Detection Limit, a statistical estimate of method/media/instrument sensitivity.
RL = Reporting Limit, a verified value of method/media/instrument sensitivity.
CRDL = Contract Required Detection Limit
Reg. Limit = Regulatory Limit.
ND = Not Detected, testing result not detected above the MDL or RL.
< This testing result is less than the numerical value.
** No result could be reported, see sample comments for details.

Qualifier Symbol Definitions

U = Qualifier indicates that the analyte was not detected above the MDL.
J = Qualifier Indicates that the analyte value is between the MDL and the RL. It is also used to indicate an estimated value for tentatively identified compounds in mass spectrometry where a 1:1 response is assumed.
B = Qualifier indicates that the analyte was detected in the blank.
E = Qualifier indicates that the analyte result exceeds calibration range.
P = Qualifier indicates that the RPD between the two columns is greater than 40%.

Quality Control Sample
Batch Report

Analysis Information

Workorder: 1733231

Limits:	Client SOW/Contract Specified	**Preparation:**	NA	**Analysis:**	EPA 6850
Basis:	DoD QSM	**Batch:**	NA	**Batch:**	ELMS/2006 (HBN: 204446)
		Prepared By:	NA	**Analyzed By:**	Thomas Bosch

Blank

LMB: 577683
Analyzed: 12/07/2017 09:41
Units: ug/L

Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 577684
Analyzed: 12/07/2017 10:00
Dilution: 1
Units: ug/L

Analyte	Result	Target	% Rec	QC Limits	
Perchlorate	5.18	5.00	104	78.8	123.8

Matrix Spike - Matrix Spike Duplicate

Sample:	1733231002	**MS:**	1733231003				**MSD:**	1733231004			
Analyzed:	12/07/2017 10:40	**Analyzed:**	12/07/2017 10:59				**Analyzed:**	12/07/2017 11:18			
Dilution:	1	**Dilution:**	1				**Dilution:**	1			
Units:	ug/L	**Units:**	ug/L				**Units:**	ug/L			

Analyte	Result	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Perchlorate	ND	4.59	5	91.8	78.8	123.8	4.95	99.0	7.59	0.0	20.0

Continuing Calibration Verification

CCV:	577680			**CCV:**	577685	
Analyzed:	12/07/2017 08:42			**Analyzed:**	12/07/2017 13:33	
Units:	ug/L			**Units:**	ug/L	
Criteria:	± 15%			**Criteria:**	± 15%	

Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	25.5	25.0	102	23.7	25.0	94.9

Interference Check Sample

ICSA: 577682
Analyzed: 12/07/2017 09:22
Units: ug/L
Criteria: ± 30%

Analyte	Result	Target	% Rec.
Perchlorate	0.927	1.00	92.7

Limit of Detection Verification

LODV:	577681			**LODV:**	577686	
Analyzed:	12/07/2017 09:03			**Analyzed:**	12/07/2017 13:52	
Units:	ug/L			**Units:**	ug/L	
Criteria:	± 50%			**Criteria:**	± 50%	

Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	1.10	1.00	110	1.06	1.00	106

Quality Control Sample
Batch Report

Analysis Information

Workorder: **1733231**

Limits:	Client SOW/Contract Specified	**Preparation:**	NA	**Analysis:**	EPA 6850
Basis:	DoD QSM	**Batch:**	NA	**Batch:**	ELMS/2006 (HBN: 204446)
		Prepared By:	NA	**Analyzed By:**	Thomas Bosch

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch	/S/ Stephen Brose
12/07/2017 14:51	12/12/2017 08:05

Symbols and Definitions

* - Analyte above reporting limit or outside of control limits
▲ - Sample result is greater than 4 times the spike added
◆ - Sample and Matrix Duplicate less than 5 times the reporting limit
● - Result is above the calibration range
- The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

18698/#2

10450 Stancliff Rd, Ste 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887
www.alsglobal.com

Subcontract Chain of Custody

COC ID: 8106

1733231

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

CUSTOMER INFORMATION:

Company:	ALS Houston
Contact:	Sonia West
Address:	10450 Stancliff Rd, Ste 210
Phone:	+1 281 530 5656
Email:	Sonia.West@alsglobal.com
Alternate Contact:	Jumoke M. Lawal
Email:	jumoke.lawal@alsglobal.com

INVOICE INFORMATION:

Company:	ALS Houston
Contact:	Accounts Payable
Address:	10450 Stancliff Rd, Ste 210
Phone:	+1 281 530 5656
Reference:	HS17111261
TSR:	Danielle Winnings

	LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
	ANALYSIS REQUESTED			DUE DATE
1.	**HS17111261-01**	**27WW02-112017**	**Groundwater**	**20 Nov 2017 13:40**
	SUB_Perch-6850			08 Dec 2017
2.	**HS17111261-02**	**27WW04-112017** Involved	**Groundwater**	**20 Nov 2017 14:40**
	SUB_Perch-6850			08 Dec 2017
3.	**HS17111261-03**	**131-112117**	**Groundwater**	**21 Nov 2017 08:35**
	SUB_Perch-6850			08 Dec 2017
4.	**HS17111261-04**	**132-112117**	**Groundwater**	**21 Nov 2017 09:30**
	SUB_Perch-6850			08 Dec 2017
5.	**HS17111261-05**	**27WW03-112117**	**Groundwater**	**21 Nov 2017 10:35**
	SUB_Perch-6850			08 Dec 2017
6.	**HS17111261-06**	**27WW01-112117**	**Groundwater**	**21 Nov 2017 11:30**
	SUB_Perch-6850			08 Dec 2017
7.	**HS17111261-07**	**27WW01-112117-a**	**Groundwater**	**21 Nov 2017 11:30**
	SUB_Perch-6850			08 Dec 2017

Comments:

Subcontract Chain of Custody

COC ID: 8106

Please analyze for the analysis listed above.
Send report to the emails shown above.

Please run HS17111261-02 as MS/MSD

QC Level: DOD IV (DoD Data Package)

Relinquished By: J. [illegible] Date/Time: 11/27/17 18:00

Received By: [signature] Date/Time: 11/28/2017 09:40

Cooler ID(s): Temperature(s):

00915436

ALS Environmental

CHAIN-OF-CUSTODY

Project / Job / Task: HS17111261	Split:	Workorder ID: 1733231	Level: ENV_LVL4	Requested Analysis
Client: ALS Environmental (Houston)		Account: 8101	Type: 250Poly	
Comments:			Preservatives	

Item	Collect Date/Time	Sample ID	Lab ID	QC	Matrix	Containers ID(s)	Containers Count	EPA 6850, DoD QSM
1	11/20/2017 13:40	27WW02-112017	1733231001		Water	A	1	A
2	11/20/2017 14:40	27WW04-112017	1733231002		Water	A	1	A
3	11/20/2017 14:40	27WW04-112017MS	1733231003	MS	Water	A	1	A
4	11/20/2017 14:40	27WW04-112017MSD	1733231004	MSD	Water	A	1	A
5	11/21/2017 08:35	131-112117	1733231005		Water	A	1	A
6	11/21/2017 09:30	132-112117	1733231006		Water	A	1	A
7	11/21/2017 10:35	27WW03-112117	1733231007		Water	A	1	A
8	11/21/2017 11:30	27WW01-112117	1733231008		Water	A	1	A
9	11/21/2017 11:30	27WW01-112117-a	1733231009		Water	A	1	A
10								

29 of 116

ORIGINAL FIELD SAMPLE CHAIN-OF-CUSTODY

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Reason for Transfer / Storage Location
Warath-Julie	11/28/2017 09:40	ALS Sample Receiving	Sample Login
[signature]	11/28/17 1500	LOB	storage
R-33.1	12-7-17/08:00	T. Bond	6850

SAMPLE PREPARATION / ANALYSIS CHAIN-OF-CUSTODY

Sample Prep / Analysis for: _____ Lab Notebook No.: _____

Prepared / Analyzed by: _____ Date / Time: _____

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Reason for Transfer / Storage Location

ALS - Salt Lake City-Related Information Report (CRIR)

Cooler or Container Information Checklist (Fill In or Circle)

Client Name: ~~ALS~~ Houston — Project/Task/Site: 733231

Date/Time of Receipt: 11/28/2017 09:40 — Number of Coolers Received: 1

Condition of Coolers:	Acceptable/Unacceptable	Temperature Control:	Present/Not Included
Cooler Custody Seals:	Present/Absent/NA Intact/Broken/NA	Location Temp Taken:	Control/Between Samples
		Are all temperatures within project specific guidelines?	Yes/No/NA
Container Custody Seals:	Present/Absent/NA Intact/Broken/NA	VOA Headspace Present?	Yes/No/NA
Ice Present:	Yes/No/NA Frozen/Melted/NA		

pH Check Performed:	Metals	Yes/No/NA	Total Phenolics	Yes/No/NA	NO3/NO2	Yes/No/NA
	Cyanide	Yes/No/NA	TPH – 418.1	Yes/No/NA	Oil & Grease	Yes/No/NA
	Sulfide	Yes/No/NA	COD	Yes/No/NA	Total Phosphorous	Yes/No/NA
	Ammonia	Yes/No/NA	TKN	Yes/No/NA	TOC Preserved	Yes/No/NA

Cooler Received	ALS Cooler No.	Temp.	Cooler Received	ALS Cooler No.	Temp.	Cooler Received	ALSL Cooler No.	Temp.
1	C17-8037	3 °C	4	C17-	°C	7	C17-	°C
2	C17-	°C	5	C17-	°C	8	C17-	°C
3	C17-	°C	6	C17-	°C	9	C17-	°C

Taken By: M Schmitt (Signature) Marianne Schmitt (Printed Name) 11/28/2017 (Date)

Client-Related Information

☐ Missing Cooler	☐ Missing Samples/Bottles	☐ Incorrect Preservation	☐ Insufficient Sample Volume
☐ Cooler Conditions	☐ Broken/Leaking Samples	☐ pH Criteria Not Met	☐ Chain of Custody Problems
☐ Missing Paperwork	☐ Incorrect Bottle Type	☐ Residual Chlorine Present	☐ Other:
☐ Missing/Incorrect Bottle Labels	☐ Cooler Temperatures Out of Range	☐ Head Space in Bottles	

Briefly Describe the Problem and the Action Taken:

E-mailed to Client? Yes ☐ No ☐

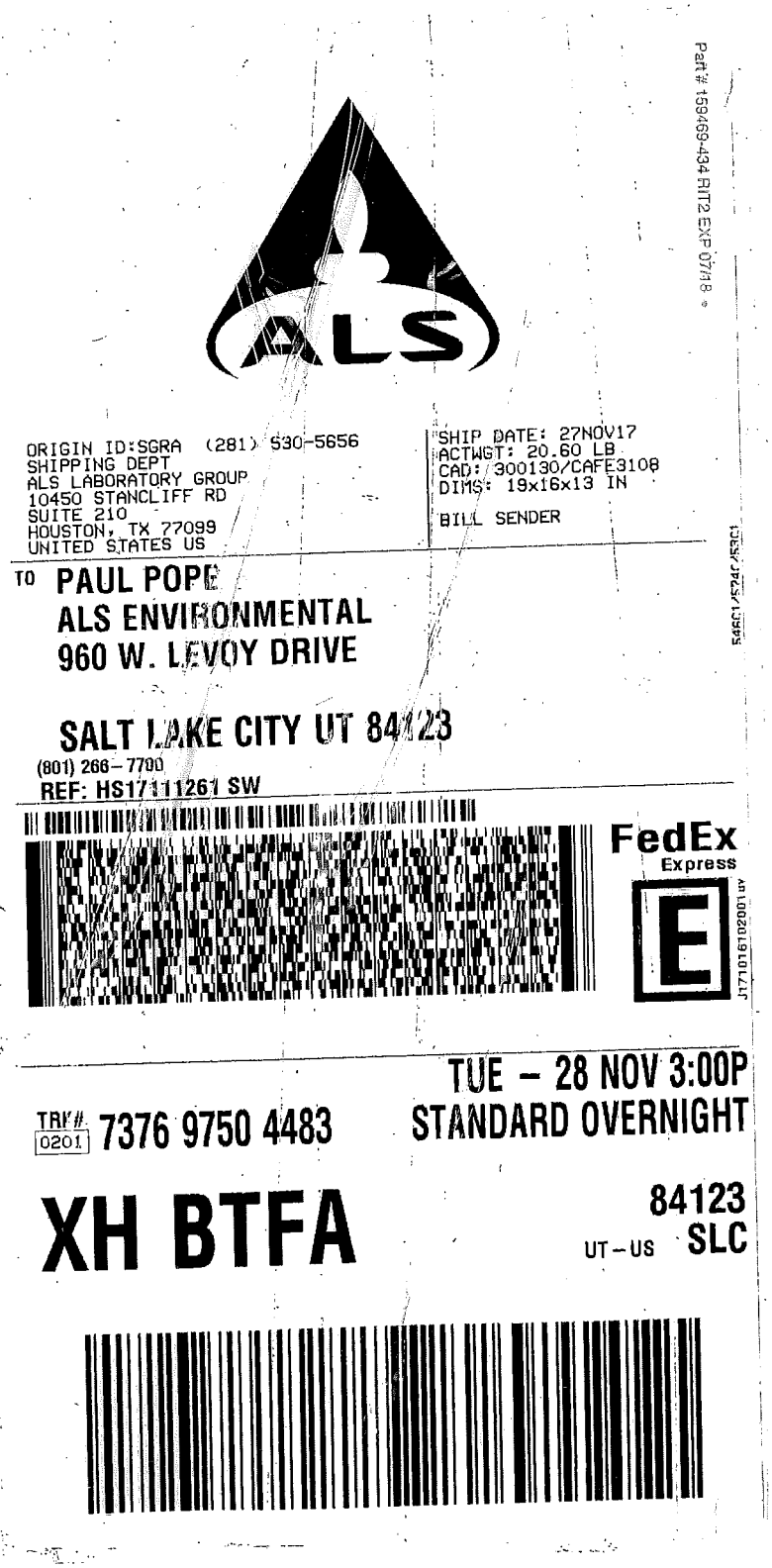
Response Required Within 24 Hours

Project Management

Project Manager Comments:

ALS Project Manager: _____ (Printed Name) Returned to Sample Receipt by: _____ (Signature) Date: _____

CRIR.dot — Revised 1/1/15



Part # 159469-434 RIT2 EXP 07/18

ORIGIN ID:SGRA (281) 530-5656
SHIPPING DEPT
ALS LABORATORY GROUP
10450 STANCLIFF RD
SUITE 210
HOUSTON, TX 77099
UNITED STATES US

SHIP DATE: 27NOV17
ACTWGT: 20.60 LB
CAD: 300130/CAFE3108
DIMS: 19x16x13 IN

BILL SENDER

TO PAUL POPE
ALS ENVIRONMENTAL
960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123
(801) 266-7700
REF: HS17111261 SW

FedEx Express

TRK# 0201 7376 9750 4483

TUE - 28 NOV 3:00P
STANDARD OVERNIGHT

XH BTFA

84123
UT-US SLC

:ch Worklist

Batch: ELMS/ 2006 **Created:** 12/7/2017 07:47 **Instrument:** HBN: 204446

Rule: EPA 6850, DoD QSM Water **Analyst:** T. Bosch **Status:** WP

Workorder: 1733231 [ENV_LVL4]

Workorder: 1733874 [ENV_LVL4]

Pos	Lab ID	Sample ID	Prep Initial	Prep Final	Dust Weight	Type	Mx	Container	Procedure	Mgr	Expire Date	Due Date	Run Date
1	577680	CCV for HBN 204446 [ELMS/2006]				CCV	3		E685041C3Q	5311		12/12/2017	
2	577681	LODV for HBN 204446 [ELMS/2006				LODV	3		E6850..D3Q	5311		12/12/2017	
3	577682	ICS for HBN 204446 [ELMS/2006]				ICS	3		E6850..D3Q	5311		12/12/2017	
4	577683	LMB for HBN 204446 [ELMS/2006]				LMB	3		E6850Q413Q	5311		12/12/2017	
5	577684	LCS for HBN 204446 [ELMS/2006]				LCS	3		E6850Q413Q	5311		12/12/2017	
6	1733231001	27WW02-112017				SAMPLE	3	1733231001-A	E6850Q41.3	5480	12/18/2017	12/12/2017	
7	1733231002	27WW04-112017				SAMPLE	3	1733231002-A	E6850Q41.3	5480	12/18/2017	12/12/2017	
8	1733231003	27WW04-112017MS				MS	3	1733231003-A	E6850Q413Q	5480		12/12/2017	
9	1733231004	27WW04-112017MSD				MSD	3	1733231004-A	E6850Q413Q	5480		12/12/2017	
10	1733231005	131-112117				SAMPLE	3	1733231005-A	E6850Q41.3	5480	12/19/2017	12/12/2017	
11	1733231006	132-112117				SAMPLE	3	1733231006-A	E6850Q41.3	5480	12/19/2017	12/12/2017	
12	1733231007	27WW03-112117				SAMPLE	3	1733231007-A	E6850Q41.3	5480	12/19/2017	12/12/2017	
13	1733231008	27WW01-112117				SAMPLE	3	1733231008-A	E6850Q41.3	5480	12/19/2017	12/12/2017	
14	1733231009	27WW01-112117-a				SAMPLE	3	1733231009-A	E6850Q41.3	5480	12/19/2017	12/12/2017	
15	1733874001	LH18/24-SP650_112917				SAMPLE	3	1733874001-A	E6850Q41.3	5480	12/27/2017	12/15/2017	
16	577685	CCV for HBN 204446 [ELMS/2006]				CCV	3		E685041C3Q	5311		12/12/2017	
17	577686	LODV for HBN 204446 [ELMS/2006				LODV	3		E6850..D3Q	5311		12/12/2017	

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #( )'s: 1733231 (001-09); 1733874 (001)
ELMS Batch/HBN ID: 2006 (204446)
Prep Date: 12/07/2017 Analysis Date: 12/07/2017 Analyst: T. Bosch
Analyte: **Perchlorate** Matrix: **Water** Method: **6850**
Sequence:\\HPCHEM\1\SEQUENCE\CLO4\2017\DEC\07DEC17P.s
Reported DL: **1.0µg/L** Reported LOD: **2.0µg/L** Reported LOQ: **4.0µg/L**

SAMPLE PREPARATION/ANALYSIS:

Water: Samples were prepared by TNB. 10.0mL of each sample was pipetted into a 15-mL centrifuge tube, and 50µL of an oxygen-18 labeled perchlorate solution was added as an internal standard. The samples were capped, vortexed, and filtered with Phenex PES membrane 0.45µm Syringe filters prior to analysis.

REAGENTS: Eluent A1: 95% ASTM Type II water (ALS)/ 5% ACN (B&J Lot DI735)/0.1% glacial acetic acid (JT-Baker Lot 04802).
Eluent B1: 95% ACN (B&J Lot DI735)/ 5% ASTM Type II water (ALS)/0.1% glacial acetic acid (JT-Baker Lot 04802).

STANDARDS: Internal Standard Spiking Solution Horizon# 38780. Dilutions of Working Standard Solution ID 32373 used for CCV's, LODV's, RLVS and IPC.

CALIBRATION CURVE: Used curve from 11/28/2017, sequence 28NOV17P.s Offline Quantitation Method: CLO4-DPR.M

INSTRUMENT CONDITIONS: Samples were analyzed with an Agilent 1100 LC/MSD system, in negative SIM mode, monitoring m/z 83, 85, and 89.
Instrument ID: LCMS04 Online Acquisition Method: CLO4-AQN.M Fragmentor: 160 Output Gain: 3 Injection Volume: 25µL
Column: KP-RPPX C8 separator, 250mm Mobile Phase: 70% Eluent A1; 30% Eluent B1

FLOW GRADIENT:

Time (min.)	Flow (mL/min)
0	0.65
4.0	0.65
5.0	0.25
14.5	0.25
15.0	0.65
17.5	0.65

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 577684; Target = 5.0µg/L. ASTM type II water was used for LMB 577683.

MS/MSD: MS/MSD was performed on samples 1733231003/04 (Client ID: 27WW04-112017). 5.0µl of Working Standard Solution Horizon ID 36735 was added to 10.0mL of sample preparation. Spike target = 5.0µg/L.

COMMENTS:

1) Results reported in µg/L.
2) All QC, Blank, CCV, and MS/MSD results were within method parameters.
3) Sample data can be viewed at two directories within the ALS system: \\ALSLTWS013\LCMS\LCMS04\2017\DEC\HBN# or through NuGenesis\Tree\PrintData\LCMS\DefaultView.
4) Due to limitations of the Chemstation Software, many of the chromatographic peaks require manual integration. Manual Integrations were performed for some of the Initial Calibration analyses (datafiles: 28NOVP01,02) along with datafiles 07DECP03/17.
5) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2017\CLO4-204446-DOD-ALS-HSTN-LCMS4 or through \\ALSLTWS013\DATAREVIEW\HBN#

STANDARD REPORT

Working Standard - CLO4 WRK

CLO4 WRK — Description - 6850 WKG Std 100.ug/L

Standard: 36735
MFG: ALS/SLC
MFG Lot: TNB: 05/10/17
Part ID:

Created By: T. Bosch
Create Date: 05/10/2017
Lab Lot: CLO4 WRK

Amount: 10 mL
Expires: 05/10/2018
Usable: Yes

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	0.1 ug/mL

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
109	ASTM H2O	ASTM Type II Water	LAB 109	9.9 mL	11/07/2025
36734	CLO4 INT	6850 Intermdt AccStd 10.ug/mL	CLO4 INT	0.1 mL	05/10/2018

STANDARD REPORT

Constituent

Stock Standard - CLO4 STOCK

CLO4 STOCK		Description - 6850 Stock AccStd 1,000ug/mL
Standard: 36733	Created By: T. Bosch	Amount: 100 mL
MFG: AccuStandard	Create Date: 5/10/2017	Expires: 10/4/2018
MFG Lot: 216095148	Lab Lot: CLO4 STOCK	Usable: Yes
Part ID: IC-PER-10X-1		

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	1000 ug/mL

STANDARD REPORT

Constituent

Solvent Standard - ASTM H2O

ASTM H2O		Description - ASTM Type II Water
Standard: 109	Created By: ALS Support (Lims)	Amount: 1000 L
MFG: DCL In House	Create Date: 10/6/2005	Expires: 11/7/2025
MFG Lot:	Lab Lot: LAB 109	Usable: Yes
Part ID:		

Pos.	Analyte	Name	Concentration
Solvent - Analyte(s) not applicable			

STANDARD REPORT

Constituent

Working Standard - CLO4 INT

CLO4 INT Description - 6850 Intermdt AccStd 10.ug/mL

Standard: 36734
MFG: ALS/SLC
MFG Lot: TNB: 05/10/17
Part ID:

Created By: T. Bosch
Create Date: 05/10/2017
Lab Lot: CLO4 INT

Amount: 10 mL
Expires: 05/10/2018
Usable: Yes

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	10 ug/mL

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
109	ASTM H2O	ASTM Type II Water	LAB 109	9.9 mL	11/07/2025
36733	CLO4 STOCK	6850 Stock AccStd 1,000ug/mL	CLO4 STOCK	0.1 mL	10/04/2018

STANDARD REPORT

Working Standard - CLO4 QC WRK

CLO4 QC WRK — Description - 6850 QC WKG STD 100ug/L

Standard: 36750
MFG: ALS/SLC
MFG Lot: TNB: 05/11/17
Part ID:

Created By: T. Bosch
Create Date: 05/11/2017
Lab Lot: CLO4 QC WRK 100.ug/L

Amount: 10 mL
Expires: 05/11/2018
Usable: Yes

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	100 ug/L

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
109	ASTM H2O	ASTM Type II Water	LAB 109	9.9 mL	11/07/2025
36749	CLO4 QC INT	6850 QC Intrmdt Std-QC 10ug/mL	CLO4 QC INT 10.ug/mL	0.1 mL	05/11/2018

STANDARD REPORT

Constituent

Working Standard - CLO4 QC INT

CLO4 QC INT — Description - 6850 QC Intrmdt Std-QC 10ug/mL

Standard: 36749
MFG: ALS/SLC
MFG Lot: TNB: 05/11/2017
Part ID:

Created By: T. Bosch
Create Date: 05/11/2017
Lab Lot: CLO4 QC INT 10.ug/mL

Amount: 10 mL
Expires: 05/11/2018
Usable: Yes

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	10 ug/mL

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
109	ASTM H2O	ASTM Type II Water	LAB 109	9.9 mL	11/07/2025
36748	CLO4 QCSTOCK	6850 QC Stock STD 1,000ug/mL	CLO4 QC STOCK	0.1 mL	03/31/2020

STANDARD REPORT

Constituent

Solvent Standard - ASTM H2O

ASTM H2O		Description - ASTM Type II Water
Standard: 109	Created By: ALS Support (Lims)	Amount: 1000 L
MFG: DCL In House	Create Date: 10/6/2005	Expires: 11/7/2025
MFG Lot:	Lab Lot: LAB 109	Usable: Yes
Part ID:		

Pos.	Analyte	Name	Concentration
Solvent - Analyte(s) not applicable			

STANDARD REPORT

Constituent

Stock Standard - CLO4 QCSTOCK

CLO4 QCSTOCK Description - 6850 QC Stock STD 1,000ug/mL

Standard: 36748
MFG: Ultra Scientific
MFG Lot: CP-0860
Part ID: ICC-013

Created By: T. Bosch
Create Date: 5/11/2017
Lab Lot: CLO4 QC STOCK

Amount: 100 mL
Expires: 3/31/2020
Usable: Yes

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	1000 ug/mL

STANDARD REPORT

Working Standard - CLO4ISTDWRK

CLO4ISTDWRK		Description - Perchlorate ISTD Wrk 1,000ug/L
Standard: 38780	Created By: Thomas Bosch	Amount: 10 mL
MFG: ALS/SLC	Create Date: 10/09/2017 01:10PM	Expires: 10/09/2018
MFG Lot: TNB: 10/09/17	Verified By: Thomas Bosch	Usable: Yes
Pipette ID: Not Provided	Verify Date:	Lab Lot: CLO4ISTDWRK

Pos.	Analyte	Name	Concentration
1	14797-73-0-8385	Perchlorate 83:85 Ratio	1000 ug/L
2	14797-73-0-89	Perchlorate 89	1000 ug/L

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
23118	CLO4ISTDSTK	Perchlorate ISTD Stock	CLO4ISTDSTK	0.1 mL	02/27/2024

STANDARD REPORT

Constituent

Stock Standard - CLO4ISTDSTK

CLO4ISTDSTK		Description - Perchlorate ISTD Stock
Standard: 23118	Created By: Thomas Bosch	Amount: 1 mL
MFG: Cambridge Isotope	Create Date: 04/04/2014 03:04PM	Expires: 02/27/2024
MFG Lot: SDDG-013	Verified By: Thomas Bosch	Usable: Yes
Part ID: OLM-7310-S	Verify Date: 02/05/2009 12:02AM	Lab Lot: CLO4ISTDSTK

Pos.	Analyte	Name	Concentration
1	14797-73-0-8385	Perchlorate 83:85 Ratio	100 ug/mL
2	14797-73-0-89	Perchlorate 89	100 ug/mL

ULTRA SCIENTIFIC
Analytical Solutions

Certificate of Analysis

ISO Guide 34 Reference Material

Product Number: ICC-013
Lot Number: CP-0860

Lot Issue Date: 29-Feb 2016
Expiration Date: 31-Mar 2020

Product Name: Perchlorate IC Standard

Description:
This Reference Material (RM) was gravimetrically prepared in accordance with ISO Guide 34 and under ULTRA Scientific's ISO 9001 registered quality system. The neat materials used for this product have been verified by ULTRA's ISO 17025 laboratory and under ULTRA's ISO Guide 34 accreditation. The analyte concentrations were verified by ULTRA's ISO 17025 accredited laboratory. For each analyte, the true value, with its uncertainty value calculated at the 95% confidence level, is reported below.

Analyte	Starting Material	Lot Number	Purity (%)	Calculated Value	True Value	Traceability & Method
perchlorate	potassium perchlorate	RM07987	100	1001 ± 5 µg/mL	976 ± 6 µg/mL	NIST SRM 3141A; ICP-OES

Solvent: water (low TOC, < 50 ppb)

Storage: Store at Room Temperature (15° to 30°C).

Traceability:
Traceability has been established through an unbroken chain of comparisons, each having stated uncertainties. Comparisons are based on appropriate physical or chemical measurements, including gravimetric or volumetric dilution, where the mass or volume of a solution before and after dilution is measured. The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1, ISO 9001, ISO 17025, and ISO Guide 34. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 819.

Estimation of Uncertainties:
The true value is reported, with its uncertainty value calculated at the 95% confidence level.

Homogeneity:
This RM was formulated and unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening and should be processed without delay for the true value to be valid within the stated uncertainties. Do not pipet from the bottle. Do not return any material removed for pipetting to the bottle. Tightly cap the bottle after removing any material and store according to the instructions noted above.

Hazards:
Refer to the Safety Data Sheet for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid, within the measurement uncertainty specified, until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

ANAB ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER
ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ULTRA SCIENTIFIC
Analytical Solutions

Certificate of Analysis

ISO Guide 34 Reference Material

Product Number: ICC-013
Lot Number: CP-0860

Lot Issue Date: 29-Feb 2016
Expiration Date: 31-Mar 2020

Maintenance of Certification:
The real-time, long term stability of the RM may be monitored over the lifetime of the certification. If substantive changes occur that affect the certification before the expiration of this certificate, ULTRA Scientific will notify the purchaser.

Peter A. King, Ph.D.
VP, Technical Operations

Daniel J. Lamendola
Director of QA/RA

125 Market Street
New Haven, CT 06513
USA

AccuStandard® Inc.

Tel (203)786-5290
Fax (203)786-5287
www.AccuStandard.com

CERTIFICATE OF ANALYSIS

AccuTrace™ Reference Standard

Catalog No: IC-PER-10X-1
Description: Perchlorate Standard
Element: Perchlorate (ClO_4)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: *Refer to SDS for complete safety information*

Signal Word: Warning

Date Certified: Oct 4, 2016
Expiration: Oct 4, 2018
Sample Size: 100 mL
Components: 1
Storage Condition: Ambient (>5 °C)

Included on ISO/IEC 17025 Scope of Accreditation: Yes

Included on ISO Guide 34 Scope of Accreditation: Yes

Component		SRM #	Prepared Concentration (µg/mL)
ClO_4	Perchlorate	Ind. Std.	1000

The gravimetric uncertainty for this product is ±0.2%. See reverse side for details.

The final solution was checked against an independent standard to verify its concentration.

We use the highest purity raw materials available to minimize impurity levels in the final solution. Typically 99.999%+ pure starting materials are used as well as ASTM Type I 18 megohm deionized water.

All solutions are filtered through a 0.2 µm filter prior to being bottled.

All glassware used in preparation is Class A and calibrated regularly.

All weights are traceable through NIST, Test No. 822-275872-11

All bottles are triple rinsed with deionized water prior to use.

Shake bottle prior to use and do not pipette directly out of the bottle. Use only cleaned Class A volumetric glassware.

We certify the accuracy of this standard to be ±0.5% of the stated value until its expiration date provided it is kept tightly capped and stored under the conditions stated above.

Certified By: Meigan O'Leary
Meigan O'Leary, Inorganic QC Manager

For use in routine laboratory analysis.

Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:
ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP

23118

Product Name: (Isotopic Label & Enrichment Specification)	PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) 100 UG/ML IN WATER
Lot Number:	SDDG-013
Catalog Number:	OLM-7310-S

Product Information

Chemical Purity Specification:	≥98%
Labeled CAS Number:	NA
Unlabeled CAS Number:	7601-89-0
MW*:	130.4
Chemical Formula:	NaCl*O4
Storage:	Store at room temperature away from light and moisture.
Stability:	See storage and expiration date.

Certification

Cambridge Isotope Laboratories, Inc. guarantees that this material meets or exceeds the specifications stated. Absolute identity as well as chemical and isotopic purities are assured by the use of unambiguous synthetic routes and multiple chemical analyses whenever possible. Results are representative of QC testing at time of release from Quality Control unless otherwise stated.

Volumetric measurements were made with Class A glassware. Gravimetry is traceable to the NIST through calibrated balances and certified, calibrated, standard weights. The calibrations are traceable to the NIST under Test No. 822/270236-04. The calibrations also meet specifications outlined in ISO 9001, ISO/IEC 17025, ANSI/NSCL Z540-1-1994, NCR Document 10CFR50 Appendix B, and applicable subdocuments.

This COA references the bulk catalog number before packaging. The COA also applies to the CIL finished good catalog number. Some possible packaging sizes and their corresponding suffix are -1.2, -1, -0.5, -10, or -0.1.

** For isotopically labeled compounds, MW listed is for the fully enriched product.*

Approved by: T. J. Eckersley

Timothy J. Eckersley, Ph.D., Quality Assurance

Quality Control Tests and Results

QC Release Date	2/27/2014
Expiration Date	2/27/2024
Concentration Based on Gravimetry	102 µg/mL
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 ± 2.8 µg/mL (k=2)

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data

Batch Report: C:\HPCHEM\1\DATA\07DEC17P\07DEC17P.B

Batch Review Method:
C:\HPCHEM\1\METHODS\CLO4-DPR.M

['#' ==> Run has not been reprocessed with Batch Review Method
'*' ==> Run has been saved with batch file]

#*	Sample	Location	Inj	SampleType	Run	Perchlorate Area	Perchlorate RT	Perchlorate Amount
*	577680 CCV@25	Vial 71	1	Control	1	1.07936e6	12.278	25.45668
*	577681 LODV@1.	Vial 72	1	Control	2	4.99378e4	12.318	1.09535
*	577682 ICS@1.	Vial 73	1	Control	3	2.98292e4	12.228	9.27102e-1
*	577683 LMB	Vial 74	1	Control	4	0.00000	0.000	0.00000
*	577684 LCS@5.	Vial 75	1	Control	5	1.98421e5	12.303	5.18387
*	1733231001	Vial 76	1	Sample	6	0.00000	0.000	0.00000
*	1733231002	Vial 77	1	Sample	7	0.00000	0.000	0.00000
*	1733231003 MS	Vial 78	1	Sample	8	1.20912e5	11.705	4.58757
*	1733231004 MSD	Vial 79	1	Sample	9	1.29308e5	11.696	4.94966
*	1733231005	Vial 80	1	Sample	10	0.00000	0.000	0.00000
*	1733231006	Vial 81	1	Sample	11	0.00000	0.000	0.00000
*	1733231007	Vial 82	1	Sample	12	0.00000	0.000	0.00000
*	1733231008	Vial 83	1	Sample	13	0.00000	0.000	0.00000
*	1733231009	Vial 84	1	Sample	14	0.00000	0.000	0.00000
*	1733874001	Vial 85	1	Sample	15	3.81121e4	12.194	1.47251
*	577685 CCV@25	Vial 71	1	Control	16	8.37964e5	12.297	23.72144
*	577686 LODV@1.	Vial 72	1	Control	17	4.16165e4	12.345	1.06333

#*	Sample	Location	Inj	SampleType	Run	CLO4-85 Area	CLO4-85 RT	CLO4-85 Amount
*	577680 CCV@25	Vial 71	1	Control	1	3.38906e5	12.288	25.33203
*	577681 LODV@1.	Vial 72	1	Control	2	1.87449e4	12.340	1.04596
*	577682 ICS@1.	Vial 73	1	Control	3	9907.45410	12.223	7.28225e-1
*	577683 LMB	Vial 74	1	Control	4	0.00000	0.000	0.00000
*	577684 LCS@5.	Vial 75	1	Control	5	6.52562e4	12.322	5.10368
*	1733231001	Vial 76	1	Sample	6	0.00000	0.000	0.00000
*	1733231002	Vial 77	1	Sample	7	0.00000	0.000	0.00000
*	1733231003 MS	Vial 78	1	Sample	8	4.44681e4	11.723	5.03069
*	1733231004 MSD	Vial 79	1	Sample	9	4.55772e4	11.704	5.21719
*	1733231005	Vial 80	1	Sample	10	0.00000	0.000	0.00000
*	1733231006	Vial 81	1	Sample	11	0.00000	0.000	0.00000
*	1733231007	Vial 82	1	Sample	12	0.00000	0.000	0.00000
*	1733231008	Vial 83	1	Sample	13	0.00000	0.000	0.00000
*	1733231009	Vial 84	1	Sample	14	0.00000	0.000	0.00000
*	1733874001	Vial 85	1	Sample	15	1.31291e4	12.201	1.34868
*	577685 CCV@25	Vial 71	1	Control	16	2.68589e5	12.309	24.00641
*	577686 LODV@1.	Vial 72	1	Control	17	1.72904e4	12.385	1.13755

#*	Sample	Location	Inj	SampleType	Run	CLO4-89-ISTD Area	CLO4-89-ISTD RT	CLO4-89-ISTD Amount
*	577680 CCV@25	Vial 71	1	Control	1	1.73402e5	12.293	5.00000
*	577681 LODV@1.	Vial 72	1	Control	2	2.15150e5	12.334	5.00000
*	577682 ICS@1.	Vial 73	1	Control	3	1.52601e5	12.225	5.00000
*	577683 LMB	Vial 74	1	Control	4	1.62415e5	12.487	5.00000
*	577684 LCS@5.	Vial 75	1	Control	5	1.73685e5	12.322	5.00000
*	1733231001	Vial 76	1	Sample	6	1.21551e5	11.723	5.00000
*	1733231002	Vial 77	1	Sample	7	1.19567e5	11.735	5.00000
*	1733231003 MS	Vial 78	1	Sample	8	1.20041e5	11.733	5.00000
*	1733231004 MSD	Vial 79	1	Sample	9	1.18714e5	11.725	5.00000
*	1733231005	Vial 80	1	Sample	10	1.20686e5	11.908	5.00000
*	1733231006	Vial 81	1	Sample	11	1.14150e5	11.731	5.00000
*	1733231007	Vial 82	1	Sample	12	1.12995e5	11.770	5.00000
*	1733231008	Vial 83	1	Sample	13	1.10308e5	11.759	5.00000
*	1733231009	Vial 84	1	Sample	14	1.11211e5	11.776	5.00000
*	1733874001	Vial 85	1	Sample	15	1.21194e5	12.209	5.00000
*	577685 CCV@25	Vial 71	1	Control	16	1.45668e5	12.315	5.00000
*	577686 LODV@1.	Vial 72	1	Control	17	1.84854e5	12.376	5.00000

*** End of Report ***

Sequence: C:\HPCHEM\1\SEQUENCE\CLO4\2017\DEC\07DEC17P.S

Sequence Table:

Method and Injection Info Part:

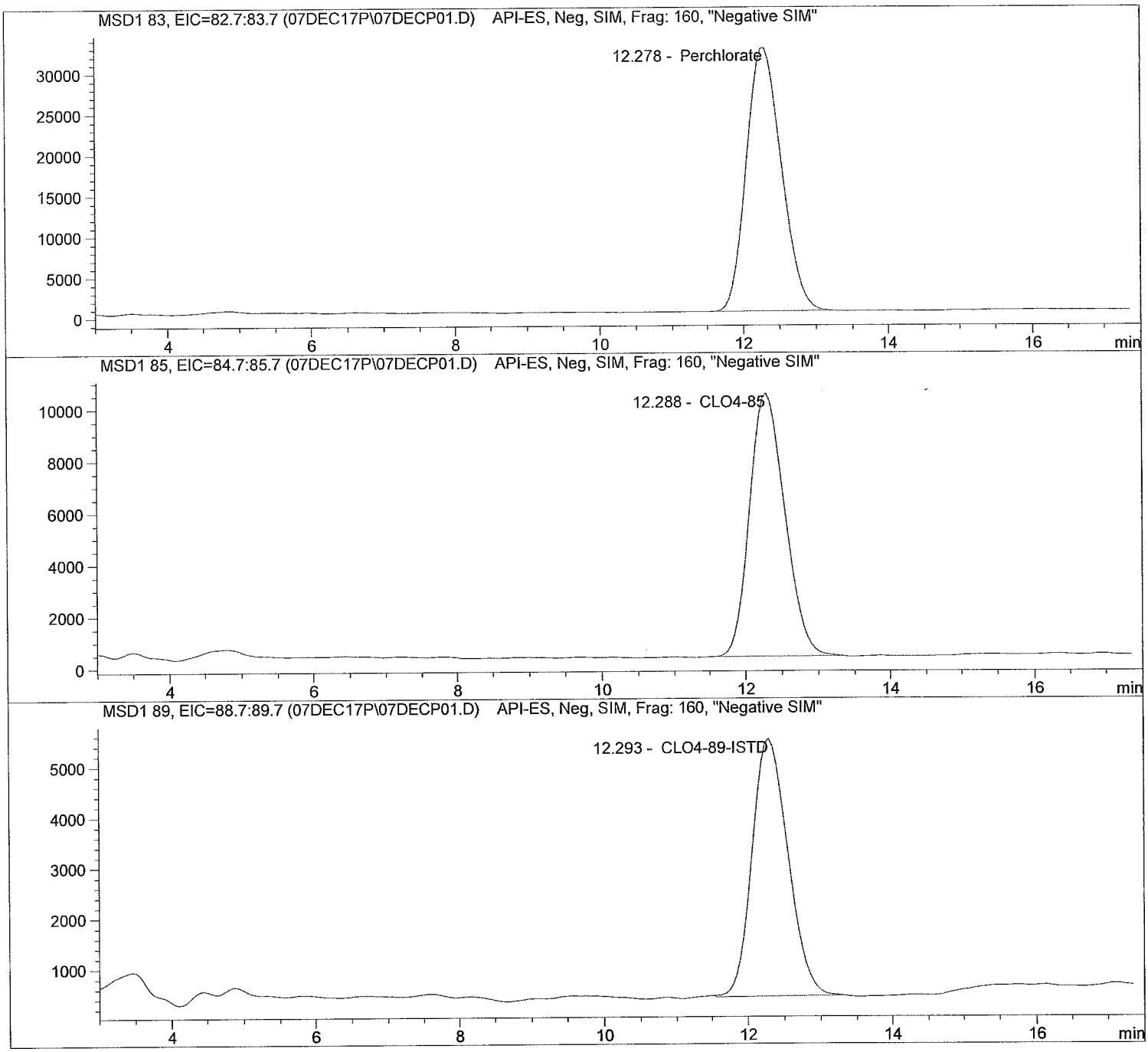
Line	Location	SampleName	Method	Inj	SampleType	InjVolume	DataFile
1	Vial 71	577680 CCV@25	CLO4-DOD	1	Ctrl Samp		
2	Vial 72	577681 LODV@1.	CLO4-DOD	1	Ctrl Samp		
3	Vial 73	577682 ICS@1.	CLO4-DOD	1	Ctrl Samp		
4	Vial 74	577683 LMB	CLO4-DOD	1	Ctrl Samp		
5	Vial 75	577684 LCS@5.	CLO4-DOD	1	Ctrl Samp		
6	Vial 76	1733231001	CLO4-DOD	1	Sample		
7	Vial 77	1733231002	CLO4-DOD	1	Sample		
8	Vial 78	1733231003 MS	CLO4-DOD	1	Sample		
9	Vial 79	1733231004 MSD	CLO4-DOD	1	Sample		
10	Vial 80	1733231005	CLO4-DOD	1	Sample		
11	Vial 81	1733231006	CLO4-DOD	1	Sample		
12	Vial 82	1733231007	CLO4-DOD	1	Sample		
13	Vial 83	1733231008	CLO4-DOD	1	Sample		
14	Vial 84	1733231009	CLO4-DOD	1	Sample		
15	Vial 85	1733874001	CLO4-DOD	1	Sample		
16	Vial 71	577685 CCV@25	CLO4-DOD	1	Ctrl Samp		
17	Vial 72	577686 LODV@1.	CLO4-DOD	1	Ctrl Samp		

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP01.D Sample Name: 577680 CCV@25

Injection Date:	12/07/2017 08:42:35	Seq Line:	1
Sample Name:	577680 CCV@25	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP01.D Sample Name: 577680 CCV@25

Injection Date:	12/07/2017 08:42:35	Seq Line:	1
Sample Name:	577680 CCV@25	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	25.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.278	PBA	1079359.2	25.4567	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.288	BBA	338906.2	25.3320	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.293	BBA	173402.2	5.0000	CLO4-89-ISTD

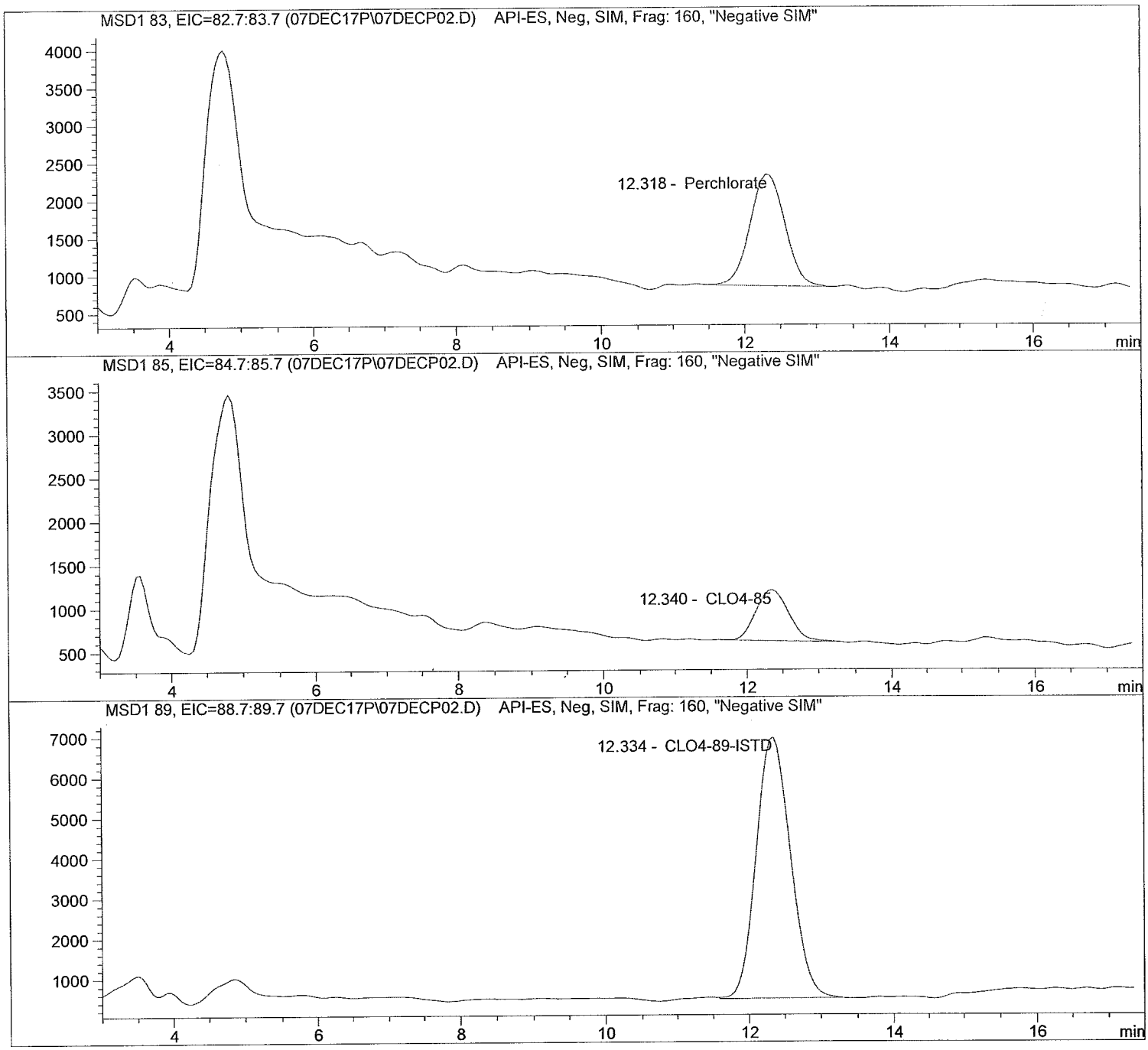
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP02.D Sample Name: 577681 LODV@1.

Injection Date:	12/07/2017 09:03:22	Seq Line:	2
Sample Name:	577681 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP02.D Sample Name: 577681 LODV@1.

Injection Date:	12/07/2017 09:03:22	Seq Line:	2
Sample Name:	577681 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.318	BBA	49937.8	1.0953	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.340	BBA	18744.9	1.0460	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.334	BBA	215149.6	5.0000	CLO4-89-ISTD

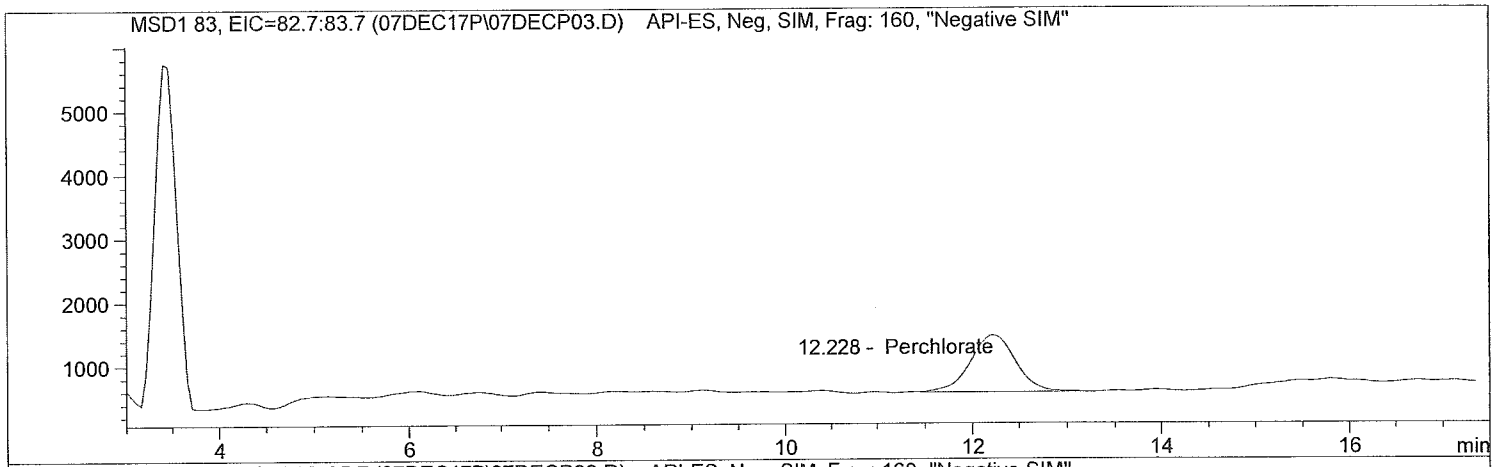
*** End of Report ***

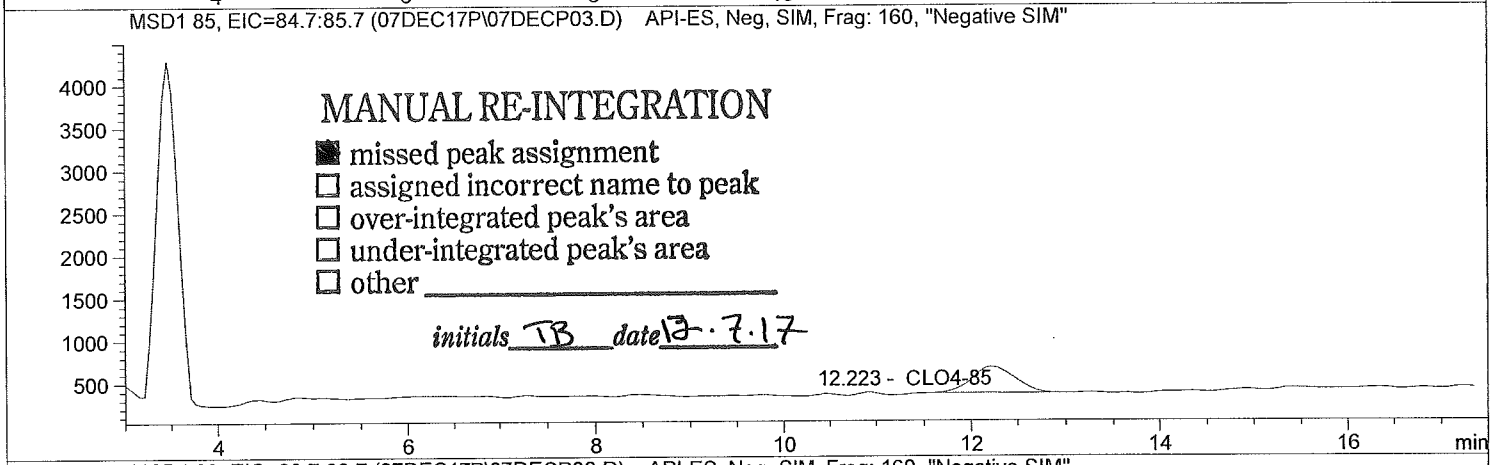
Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP03.D Sample Name: 577682 ICS@1.

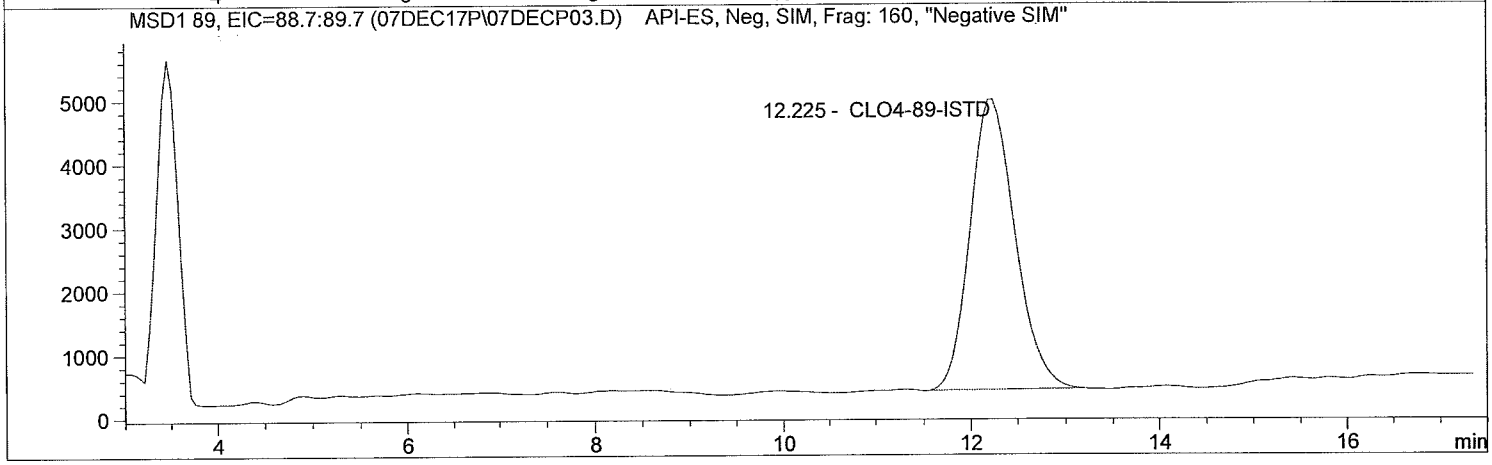
Injection Date:	12/07/2017 09:22:29	Seq Line:	3
Sample Name:	577682 ICS@1.	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP03.D Sample Name: 577682 ICS@1.

Injection Date:	12/07/2017 09:22:29	Seq Line:	3
Sample Name:	577682 ICS@1.	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.228	BBA	29829.2	0.9271	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.223	MM	9907.5	0.7282	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.225	PBA	152600.9	5.0000	CLO4-89-ISTD

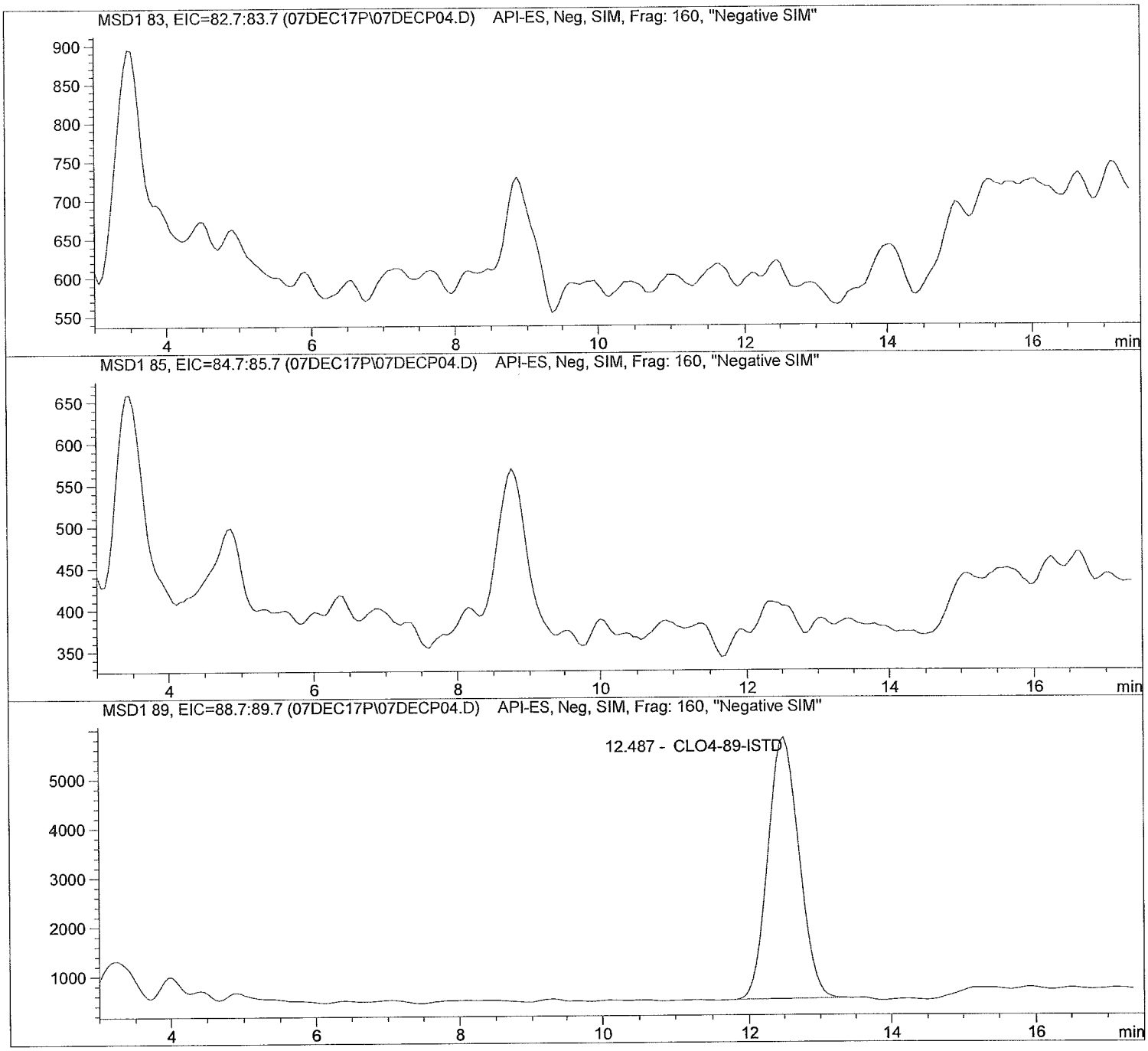
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP04.D Sample Name: 577683 LMB

Injection Date:	12/07/2017 09:41:40	Seq Line:	4
Sample Name:	577683 LMB	Location:	Vial 74
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP04.D Sample Name: 577683 LMB

Injection Date:	12/07/2017 09:41:40	Seq Line:	4
Sample Name:	577683 LMB	Location:	Vial 74
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.487	PBA	162415.5	5.0000	CLO4-89-ISTD

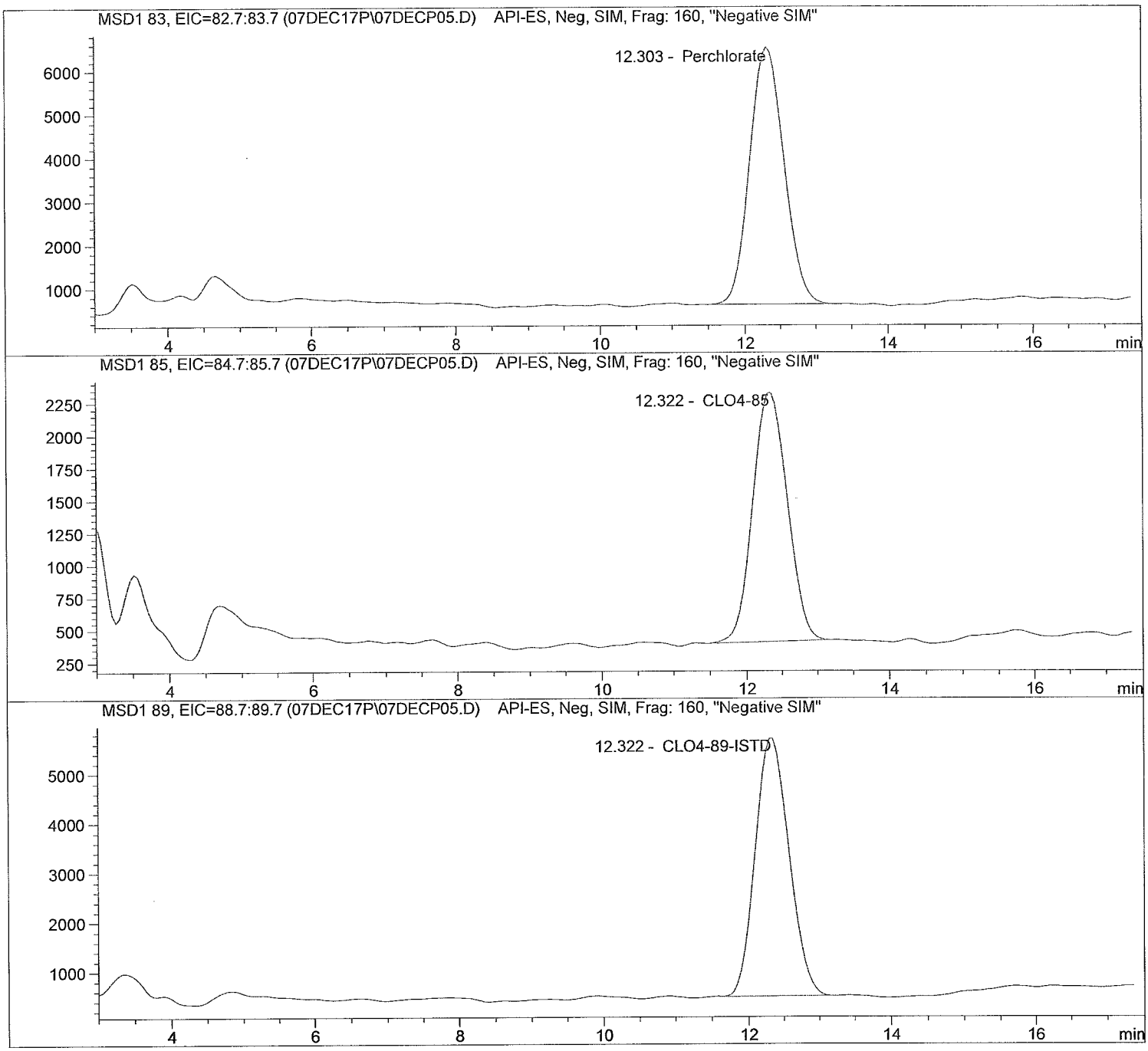
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP05.D Sample Name: 577684 LCS@5.

Injection Date:	12/07/2017 10:00:48	Seq Line:	5
Sample Name:	577684 LCS@5.	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP05.D Sample Name: 577684 LCS@5.

Injection Date:	12/07/2017 10:00:48	Seq Line:	5
Sample Name:	577684 LCS@5.	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	5.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.303	PBA	198421.5	5.1839	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.322	BBA	65256.2	5.1037	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.322	BBA	173685.1	5.0000	CLO4-89-ISTD

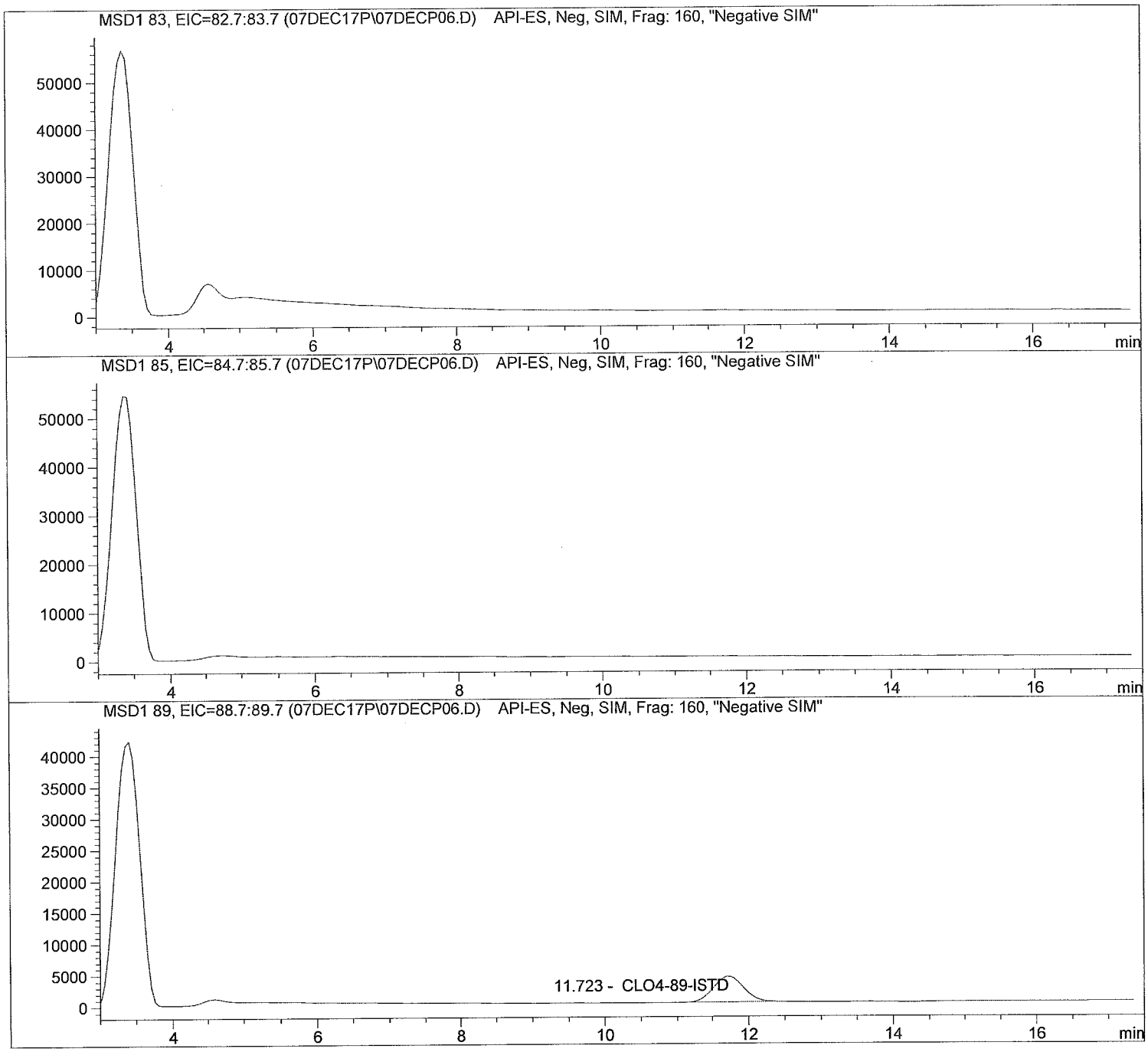
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP06.D Sample Name: 1733231001

Injection Date:	12/07/2017 10:19:59	Seq Line:	6
Sample Name:	1733231001	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP06.D Sample Name: 1733231001

Injection Date:	12/07/2017 10:19:59	Seq Line:	6
Sample Name:	1733231001	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.723	PBA	121551.4	5.0000	CLO4-89-ISTD

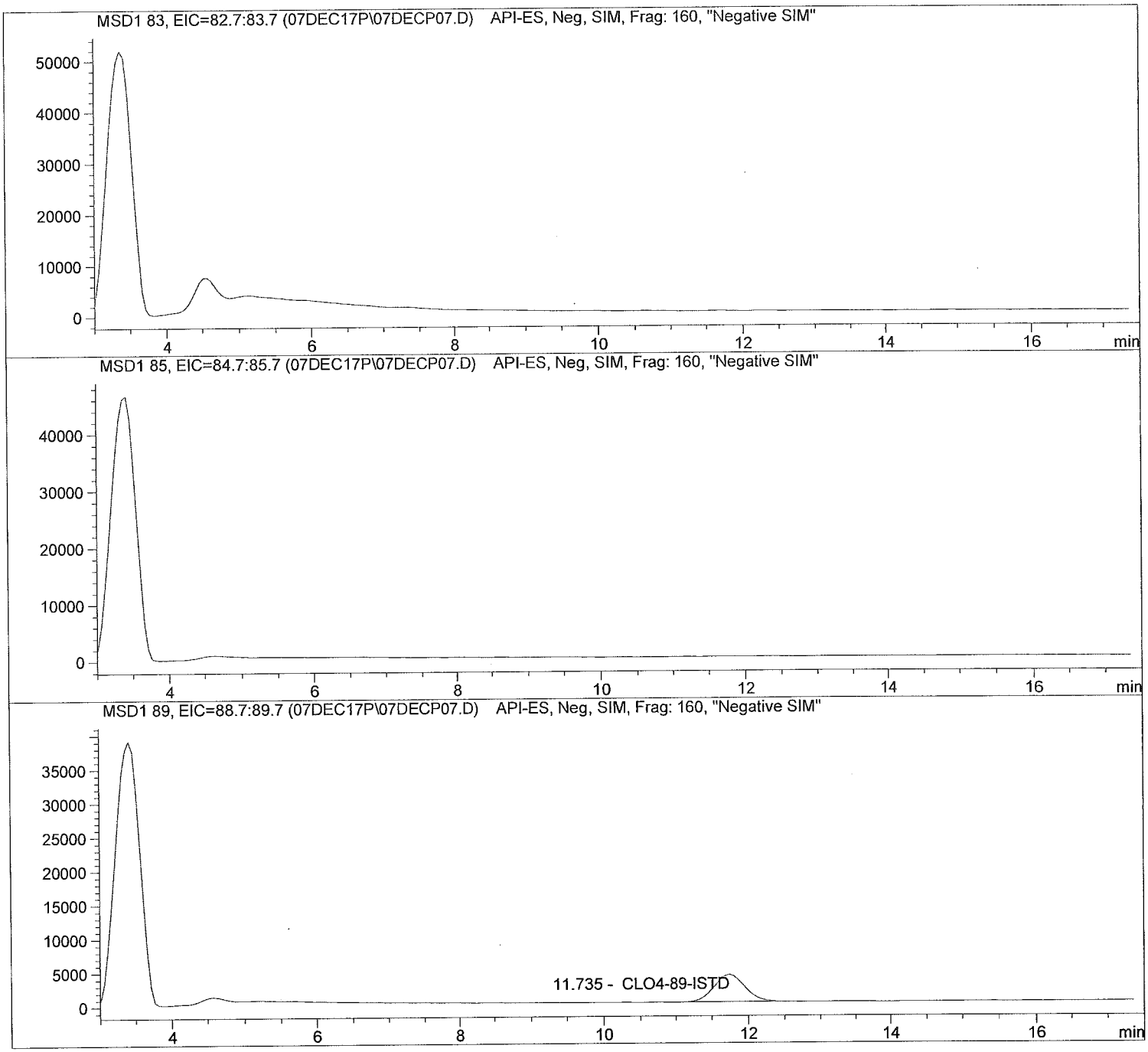
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP07.D Sample Name: 1733231002

Injection Date:	12/07/2017 10:40:35	Seq Line:	7
Sample Name:	1733231002	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP07.D Sample Name: 1733231002

Injection Date:	12/07/2017 10:40:35	Seq Line:	7
Sample Name:	1733231002	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.735	PBA	119566.6	5.0000	CLO4-89-ISTD

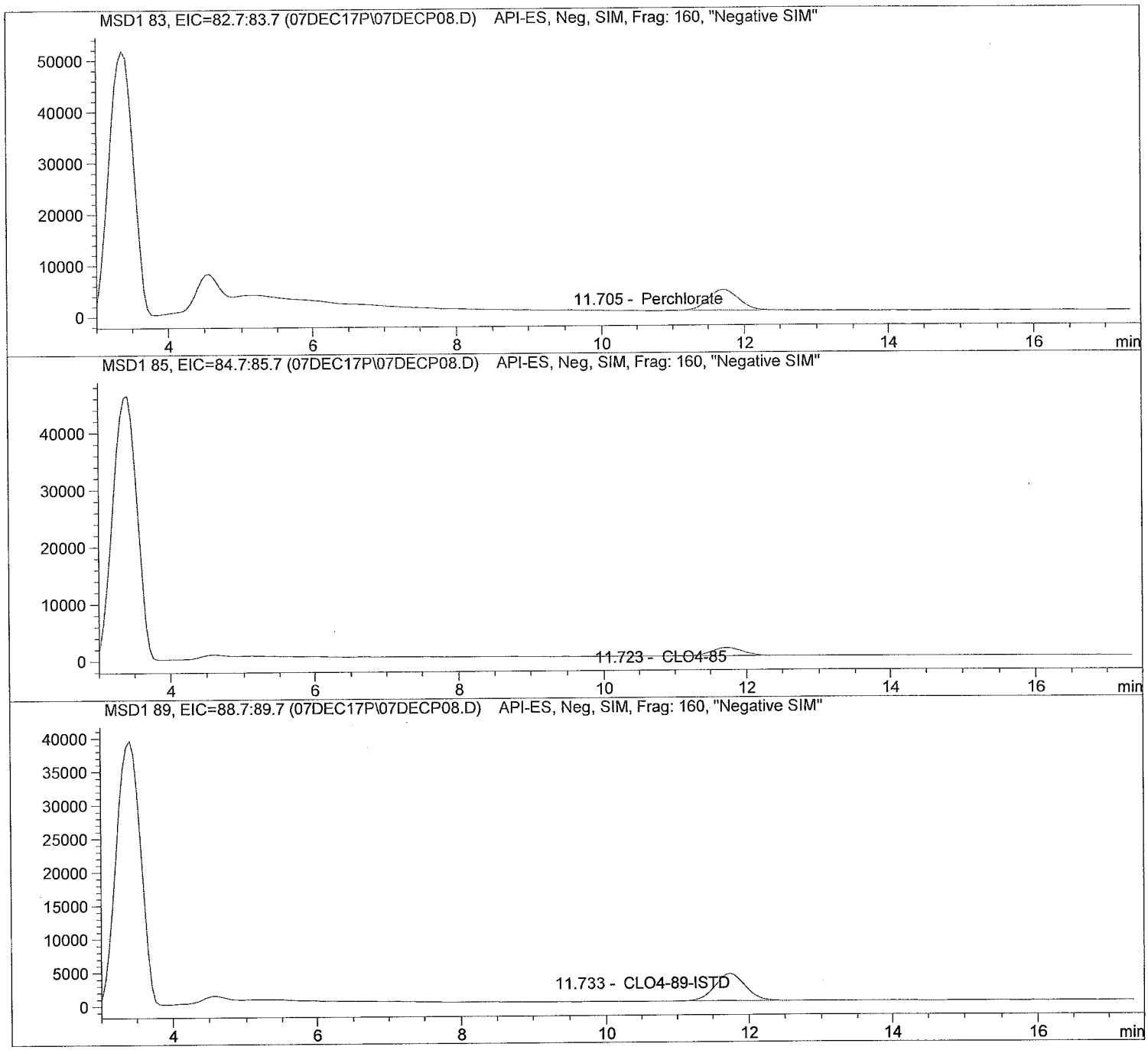
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP08.D Sample Name: 1733231003 MS

Injection Date:	12/07/2017 10:59:46	Seq Line:	8
Sample Name:	1733231003 MS	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP08.D Sample Name: 1733231003 MS

Injection Date:	12/07/2017 10:59:46	Seq Line:	8
Sample Name:	1733231003 MS	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.705	BBA	120911.8	4.5876	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.723	BBA	44468.1	5.0307	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.733	BBA	120040.7	5.0000	CLO4-89-ISTD

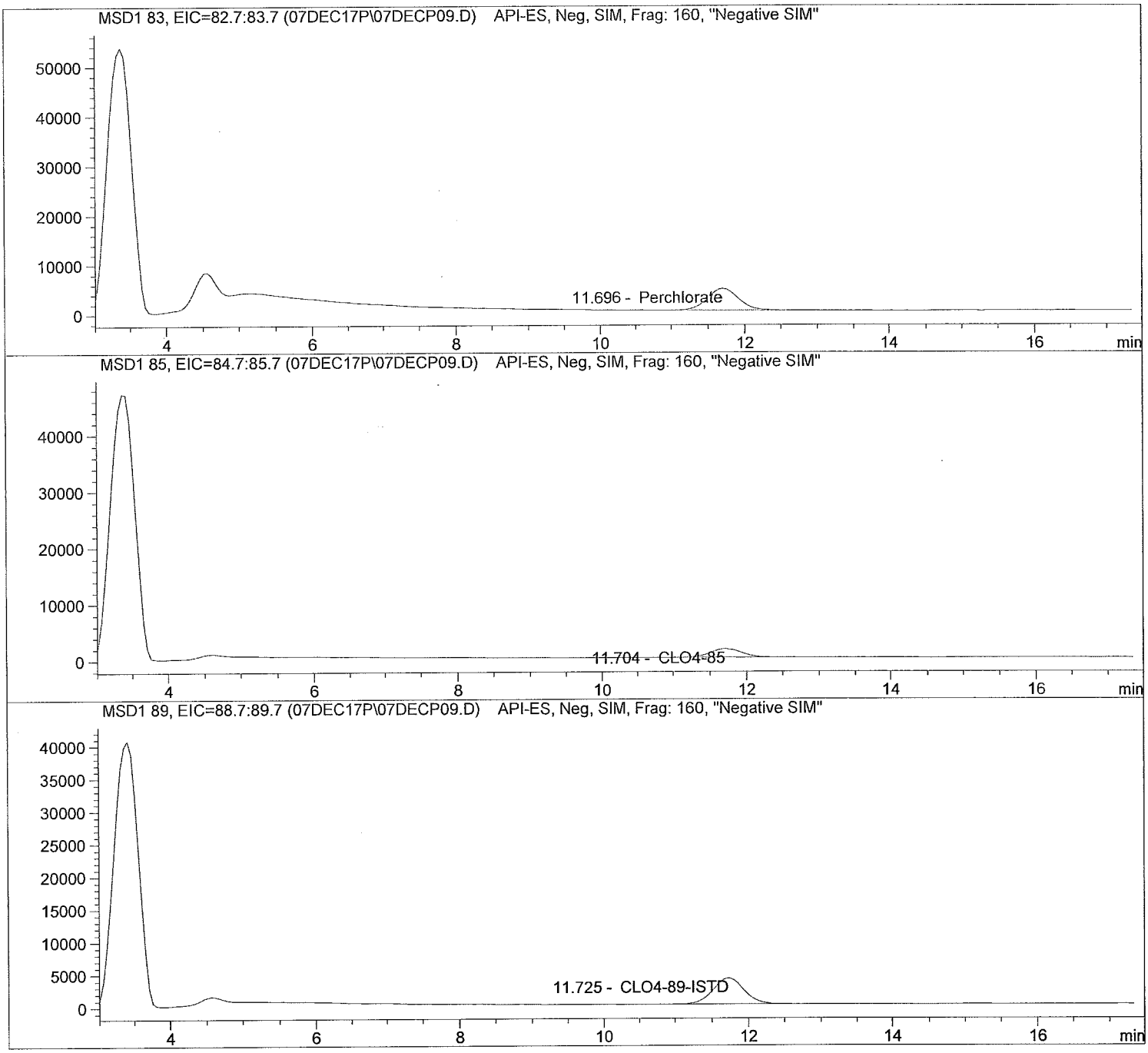
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP09.D Sample Name: 1733231004 MSD

Injection Date:	12/07/2017 11:18:56	Seq Line:	9
Sample Name:	1733231004 MSD	Location:	Vial 79
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP09.D Sample Name: 1733231004 MSD

Injection Date:	12/07/2017 11:18:56	Seq Line:	9
Sample Name:	1733231004 MSD	Location:	Vial 79
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.696	BBA	129307.8	4.9497	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.704	BBA	45577.2	5.2172	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.725	BBA	118714.4	5.0000	CLO4-89-ISTD

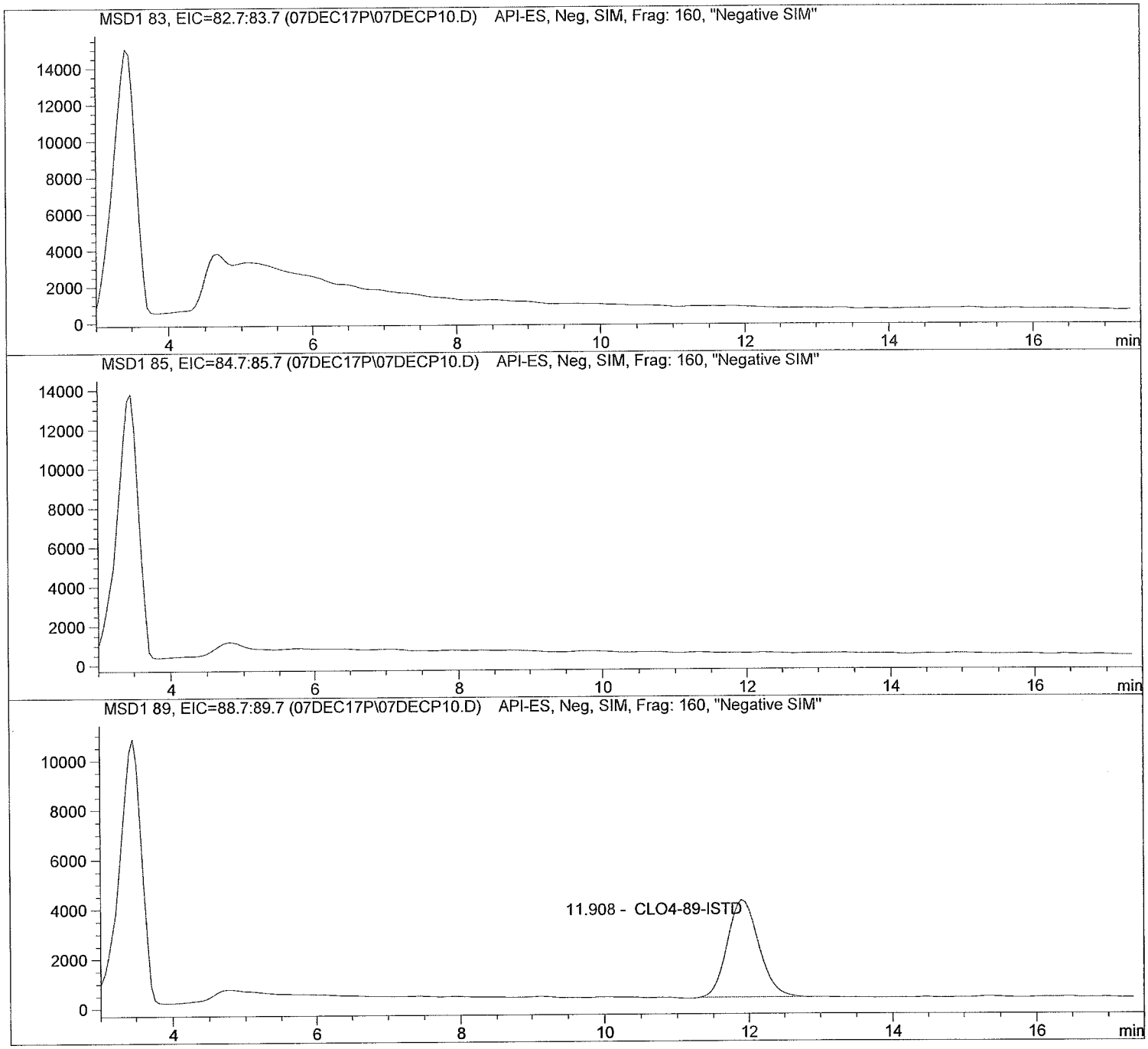
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP10.D Sample Name: 1733231005

Injection Date:	12/07/2017 11:38:08	Seq Line:	10
Sample Name:	1733231005	Location:	Vial 80
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP10.D Sample Name: 1733231005

Injection Date:	12/07/2017 11:38:08	Seq Line:	10
Sample Name:	1733231005	Location:	Vial 80
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.908	PBA	120685.7	5.0000	CLO4-89-ISTD

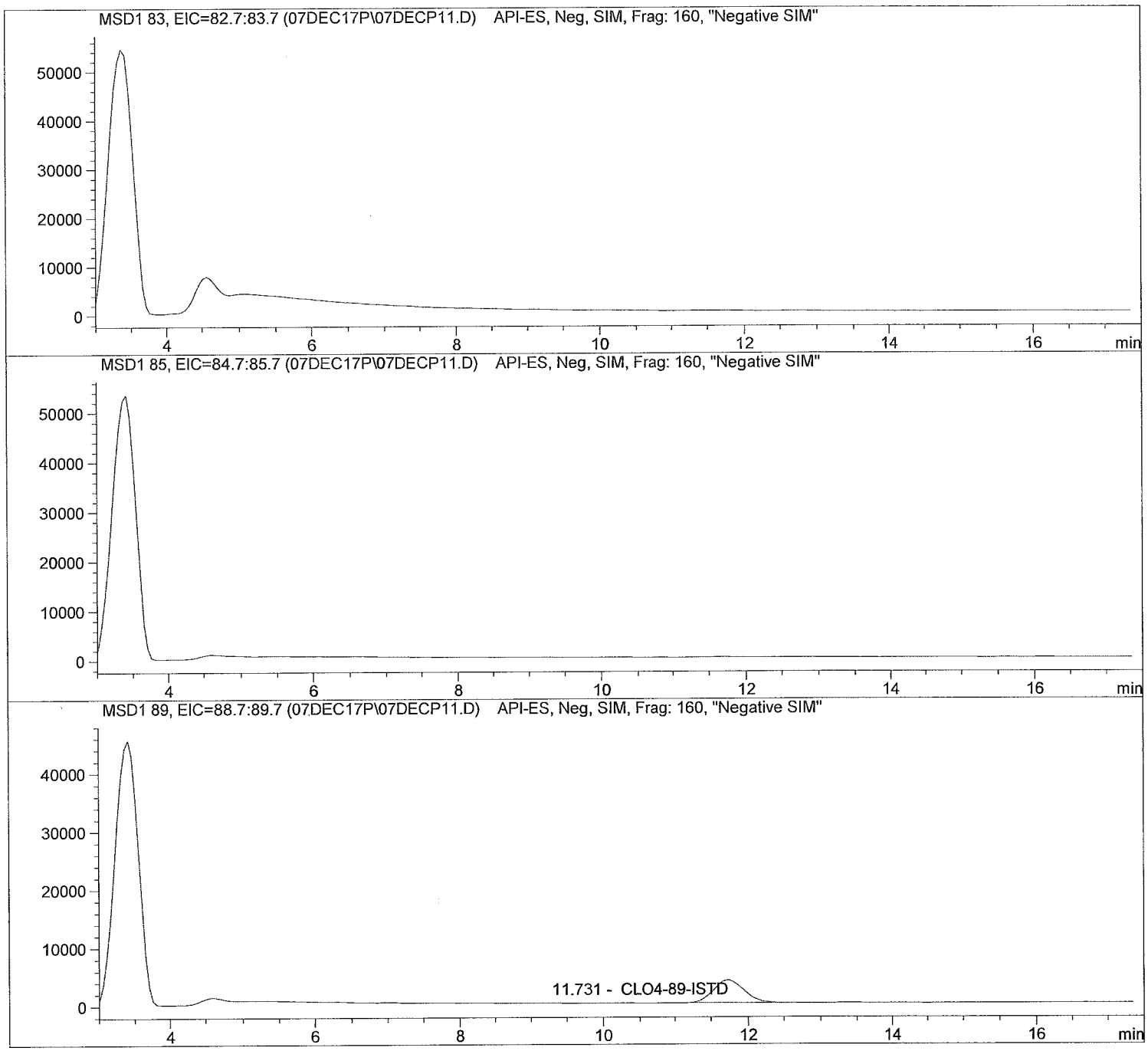
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP11.D Sample Name: 1733231006

Injection Date:	12/07/2017 11:57:19	Seq Line:	11
Sample Name:	1733231006	Location:	Vial 81
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP11.D Sample Name: 1733231006

Injection Date:	12/07/2017 11:57:19	Seq Line:	11
Sample Name:	1733231006	Location:	Vial 81
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.731	BBA	114150.3	5.0000	CLO4-89-ISTD

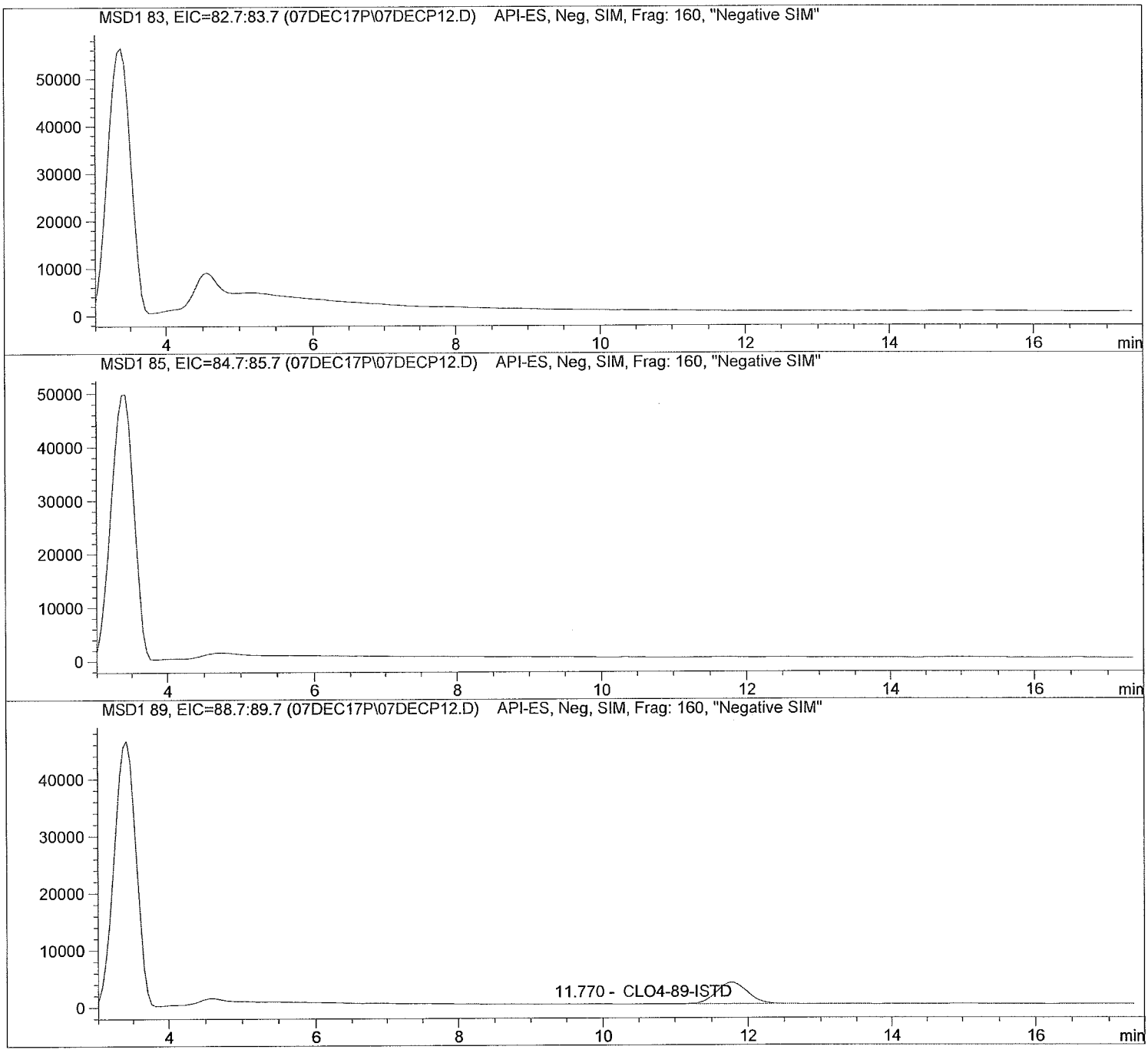
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP12.D Sample Name: 1733231007

Injection Date:	12/07/2017 12:16:26	Seq Line:	12
Sample Name:	1733231007	Location:	Vial 82
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP12.D Sample Name: 1733231007

Injection Date:	12/07/2017 12:16:26	Seq Line:	12
Sample Name:	1733231007	Location:	Vial 82
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-DOD.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.770	PBA	112994.9	5.0000	CLO4-89-ISTD

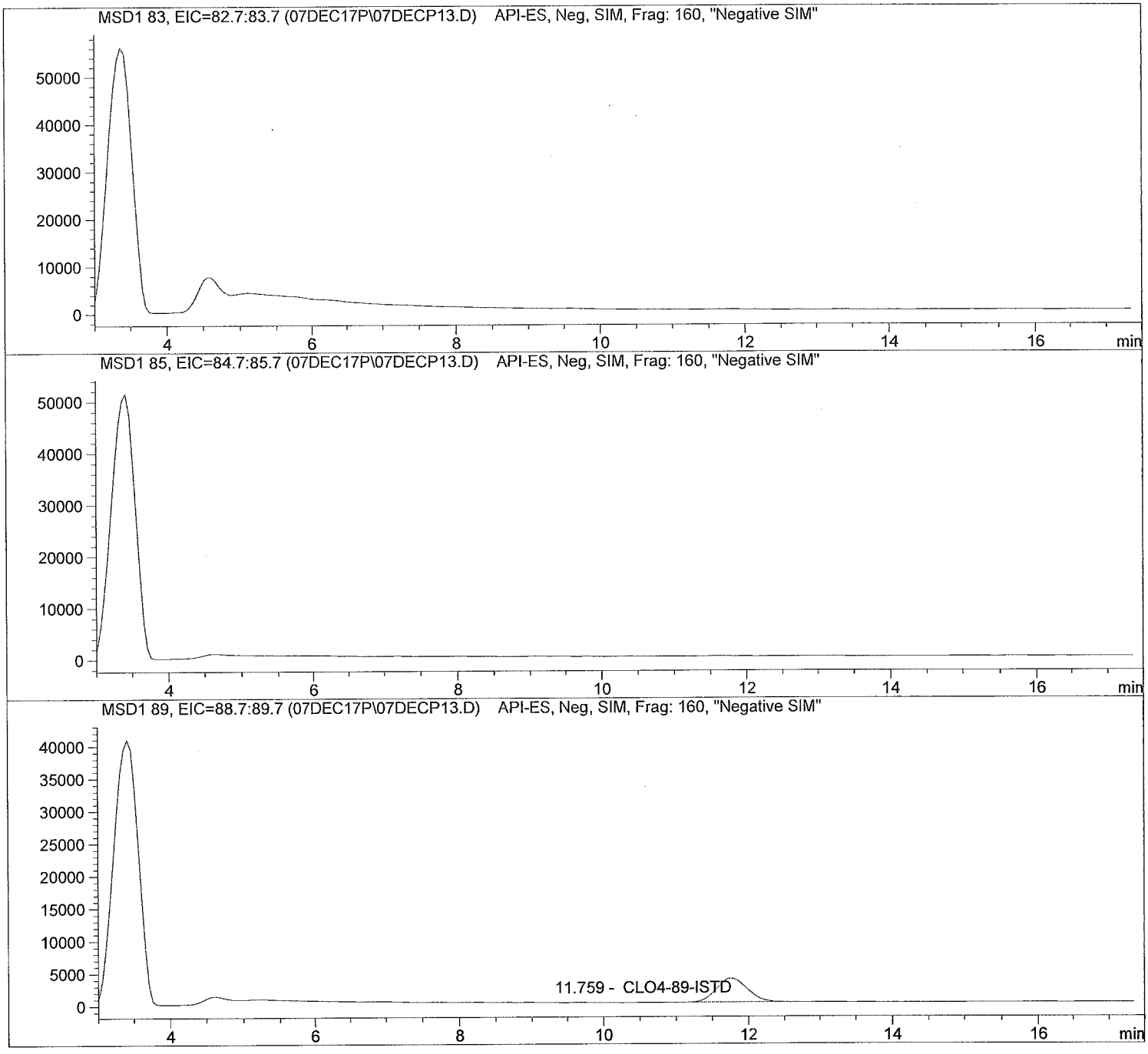
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP13.D Sample Name: 1733231008

Injection Date:	12/07/2017 12:35:33	Seq Line:	13
Sample Name:	1733231008	Location:	Vial 83
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP13.D Sample Name: 1733231008

Injection Date:	12/07/2017 12:35:33	Seq Line:	13
Sample Name:	1733231008	Location:	Vial 83
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.759	BBA	110308.3	5.0000	CLO4-89-ISTD

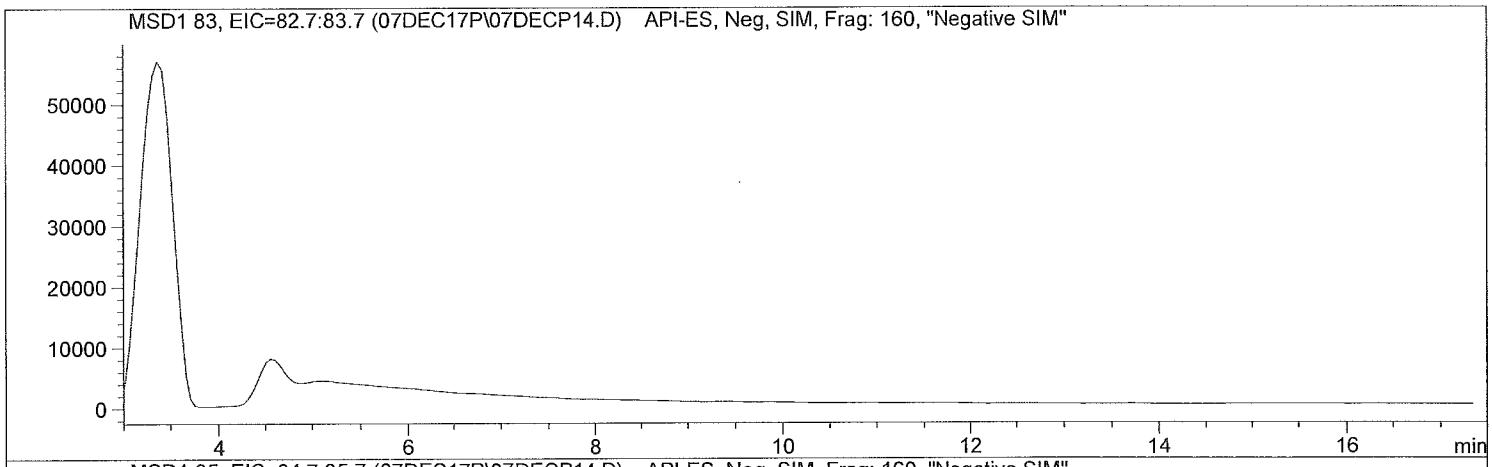
*** End of Report ***

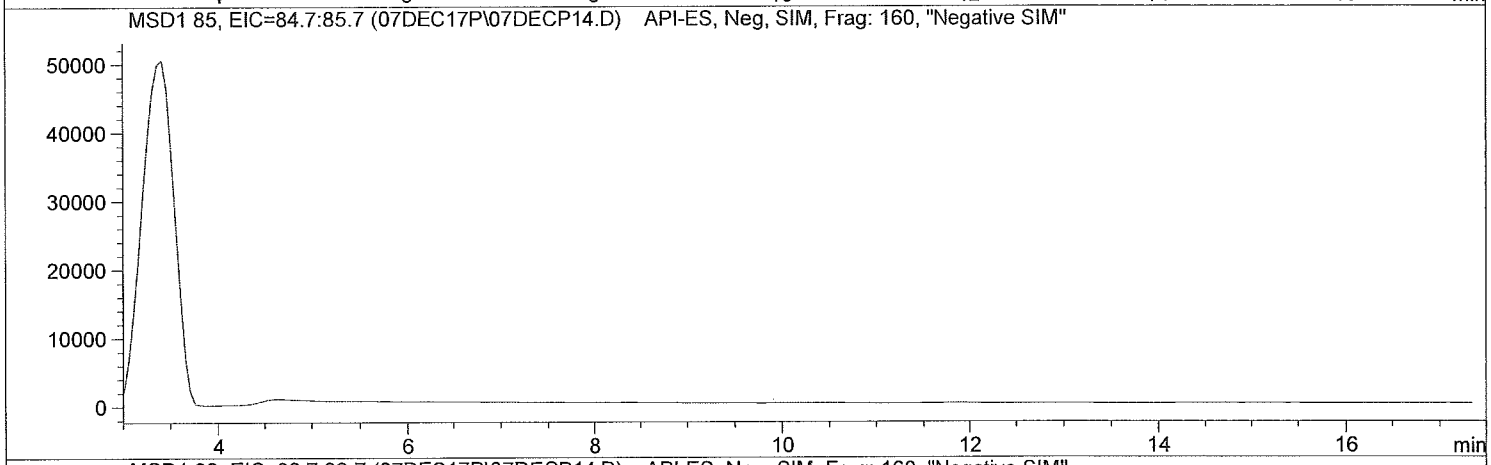
Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP14.D Sample Name: 1733231009

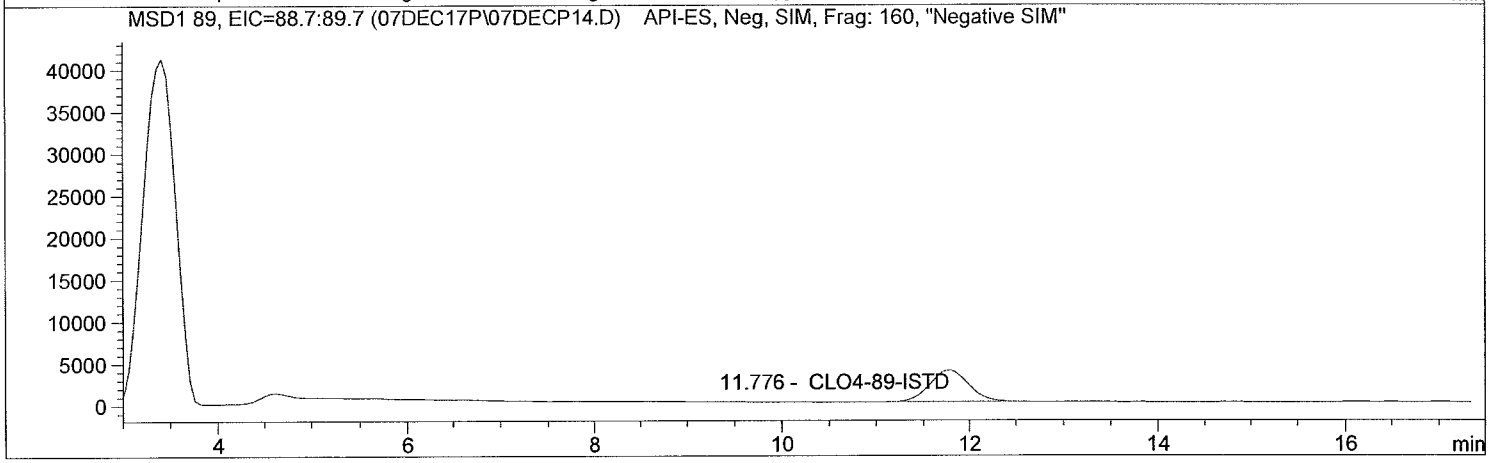
Injection Date:	12/07/2017 12:54:41	Seq Line:	14
Sample Name:	1733231009	Location:	Vial 84
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP14.D Sample Name: 1733231009

Injection Date:	12/07/2017 12:54:41	Seq Line:	14
Sample Name:	1733231009	Location:	Vial 84
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
11.776	BBA	111211.3	5.0000	CLO4-89-ISTD

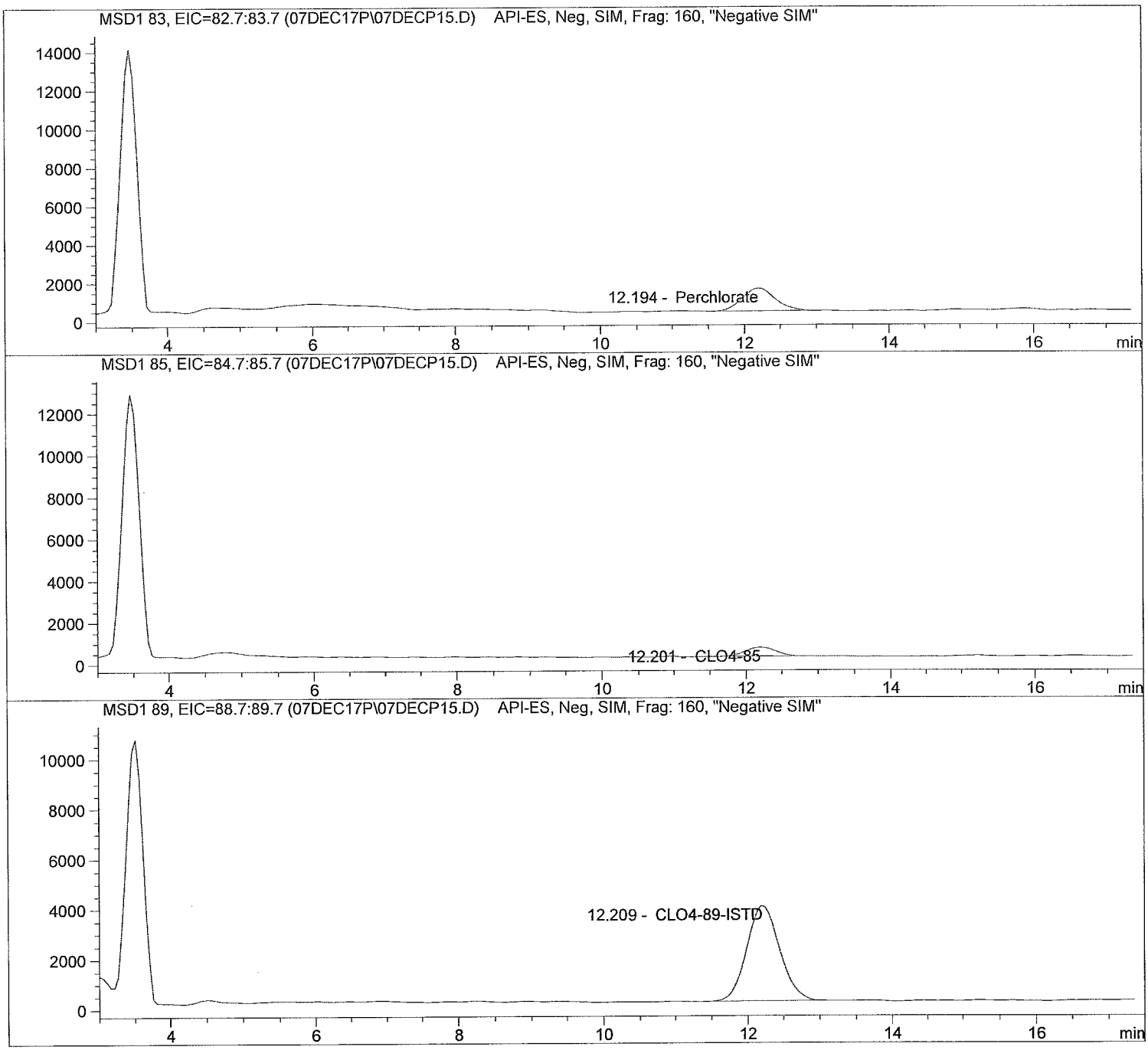
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP15.D Sample Name: 1733874001

Injection Date:	12/07/2017 13:13:51	Seq Line:	15
Sample Name:	1733874001	Location:	Vial 85
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP15.D Sample Name: 1733874001

Injection Date:	12/07/2017 13:13:51	Seq Line:	15
Sample Name:	1733874001	Location:	Vial 85
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.194	PBA	38112.1	1.4725	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.201	PBA	13129.1	1.3487	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.209	PBA	121194.1	5.0000	CLO4-89-ISTD

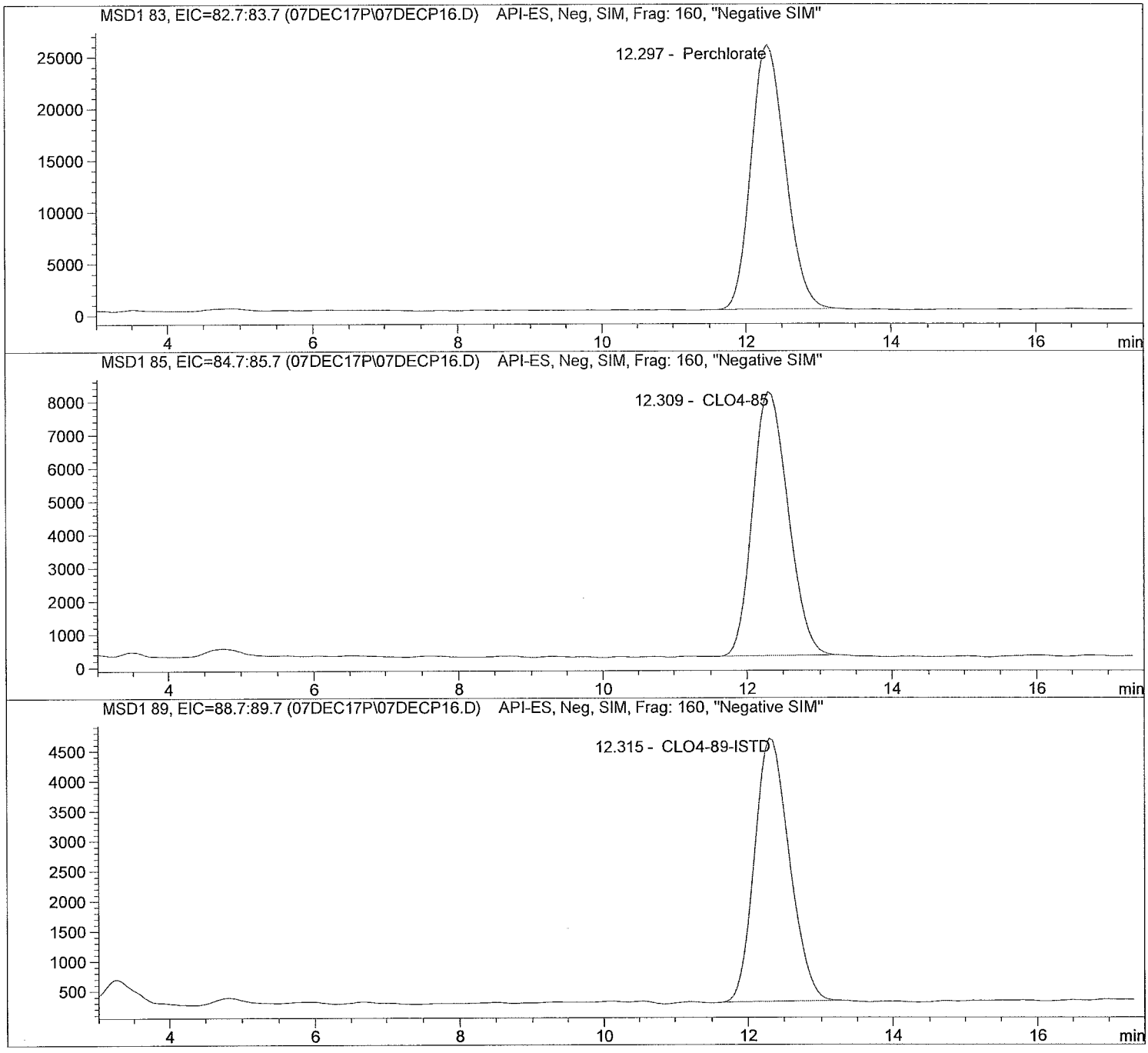
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP16.D Sample Name: 577685 CCV@25

Injection Date:	12/07/2017 13:33:00	Seq Line:	16
Sample Name:	577685 CCV@25	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP16.D Sample Name: 577685 CCV@25

Injection Date:	12/07/2017 13:33:00	Seq Line:	16
Sample Name:	577685 CCV@25	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	25.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.297	PBA	837963.8	23.7214	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.309	PBA	268589.1	24.0064	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.315	PBA	145667.7	5.0000	CLO4-89-ISTD

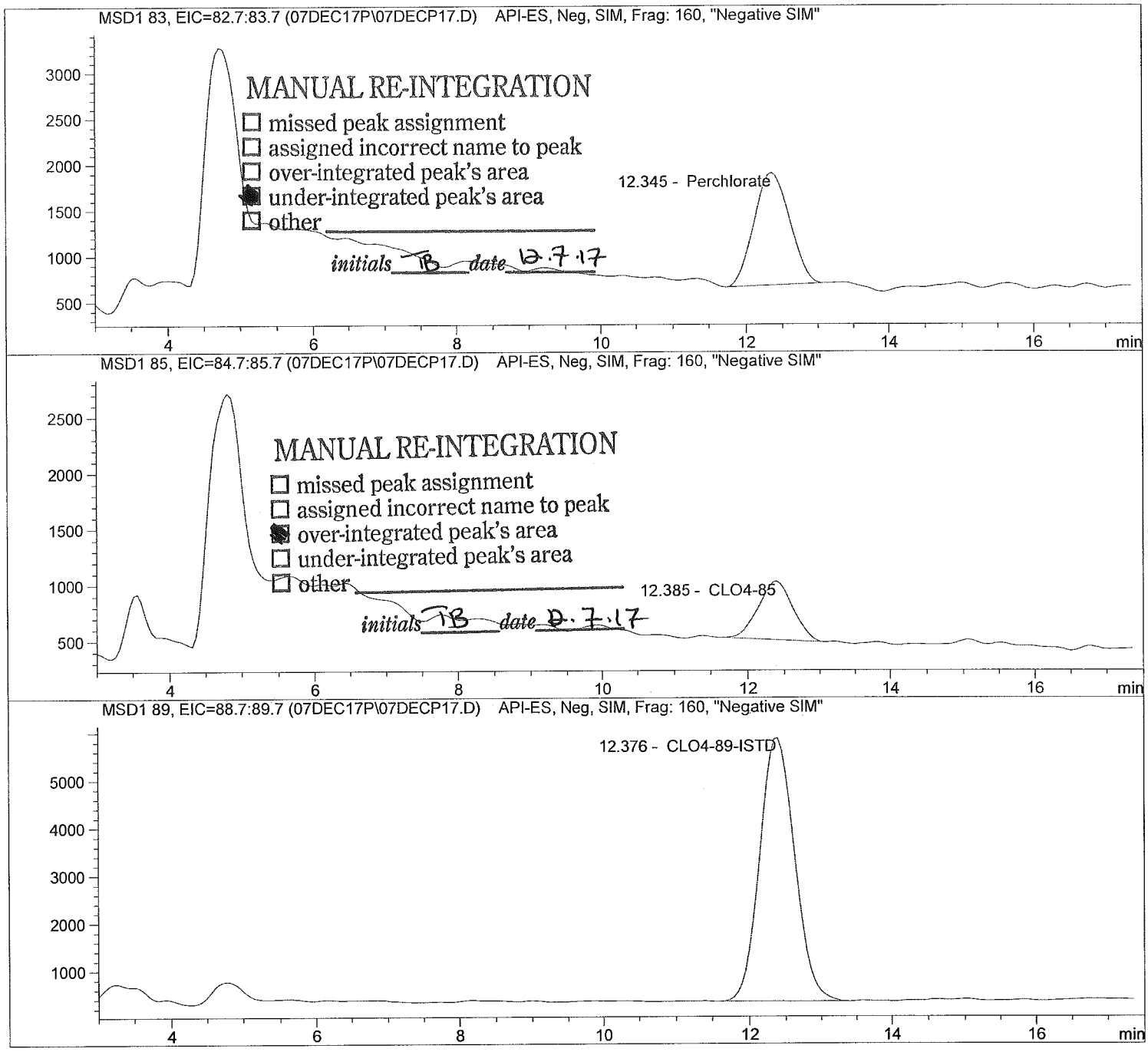
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP17.D Sample Name: 577686 LODV@1.

Injection Date:	12/07/2017 13:52:07	Seq Line:	17
Sample Name:	577686 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP17.D Sample Name: 577686 LODV@1.

Injection Date:	12/07/2017 13:52:07	Seq Line:	17
Sample Name:	577686 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.345	MM	41616.5	1.0633	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.385	MM	17290.4	1.1375	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.376	PBA	184854.0	5.0000	CLO4-89-ISTD

*** End of Report ***

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data

Initial Calibration

ethod C:\HPCHEM\1\METHODS\CLO4-DPR.M

Calibration Table

Perchlorate

Calib. Data Modified : 11/29/2017 8:02:06 AM

Calculate : Internal Standard
Based on : Peak Area

Rel. Reference Window : 20.000 %
Abs. Reference Window : 0.000 min
Rel. Non-ref. Window : 20.000 %
Abs. Non-ref. Window : 0.000 min
Use Multiplier & Dilution Factor with ISTDs
Uncalibrated Peaks : not reported
Partial Calibration : No recalibration if peaks missing

Curve Type : Quadratic (some peaks differ, see below)
Origin : Ignored (some peaks differ, see below)
Weight : Linear (Amnt) (some peaks differ, see below)

Recalibration Settings:
Average Response : Average all calibrations
Average Retention Time: Floating Average New 75%

Calibration Report Options :
Printout of recalibrations within a sequence:
Calibration Table after Recalibration
Normal Report after Recalibration
If the sequence is done with bracketing:
Results of first cycle (ending previous bracket)

Default Sample ISTD Information (if not set in sample table):

ISTD #	ISTD Amount	Name
1	5.00000	CLO4-89-ISTD

Signal 1: MSD1 83, EIC=82.7:83.7
Signal 2: MSD1 85, EIC=84.7:85.7
Signal 3: MSD1 89, EIC=88.7:89.7

RetTime [min]	Sig	Lvl	Amount	Area	Amt/Area	Ref	Grp	Name
12.090	1	1	1.00000	4.10942e4	2.43343e-5		1	Perchlorate
		2	2.00000	7.74077e4	2.58372e-5			
		3	5.00000	1.92985e5	2.59088e-5			
		4	10.00000	3.91583e5	2.55374e-5			
		5	25.00000	1.09763e6	2.27764e-5			
		6	50.00000	2.29834e6	2.17549e-5			
		7	75.00000	3.73021e6	2.01061e-5			
12.106	2	1	1.00000	1.56787e4	6.37808e-5		1	CLO4-85
		2	2.00000	2.80487e4	7.13046e-5			
		3	5.00000	6.51323e4	7.67668e-5			
		4	10.00000	1.31325e5	7.61471e-5			
		5	25.00000	3.46913e5	7.20642e-5			
		6	50.00000	6.96156e5	7.18230e-5			
		7	75.00000	1.13077e6	6.63264e-5			
12.107	3	1	5.00000	1.88880e5	2.64718e-5	+I1		CLO4-89-ISTD
		2	5.00000	1.81109e5	2.76076e-5			
		3	5.00000	1.75128e5	2.85505e-5			
		4	5.00000	1.80962e5	2.76301e-5			
		5	5.00000	1.75597e5	2.84743e-5			
		6	5.00000	1.69148e5	2.95599e-5			
		7	5.00000	1.64867e5	3.03275e-5			

ethod C:\HPCHEM\1\METHODS\CLO4-DPR.M

More compound-specific settings:

Compound: Perchlorate
- Time Window : From 8.390 min To 13.052 min
- Curve Type : Quadratic
- Origin : Ignored
- Calibration Level Weights:/
  - Level 1 : 1
  - Level 2 : 0.5
  - Level 3 : 0.2
  - Level 4 : 0.1
  - Level 5 : 0.04
  - Level 6 : 0.02
  - Level 7 : 0.013333

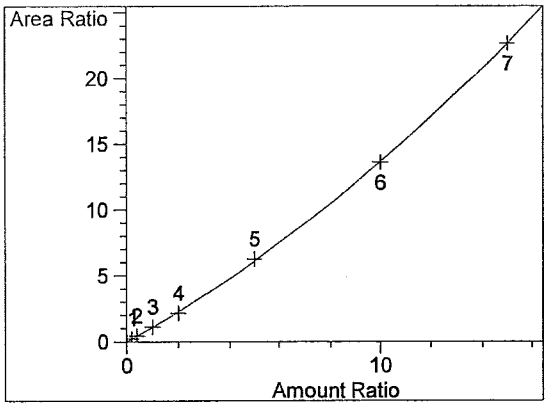
Compound: CLO4-85
- Time Window : From 8.366 min To 13.046 min
- Curve Type : Quadratic
- Origin : Ignored
- Calibration Level Weights:/
  - Level 1 : 1
  - Level 2 : 0.5
  - Level 3 : 0.2
  - Level 4 : 0.1
  - Level 5 : 0.04
  - Level 6 : 0.02
  - Level 7 : 0.013333

Compound: CLO4-89-ISTD
- Time Window : From 8.457 min To 13.107 min
- Curve Type : Linear
- Origin : Included
- Calibration Level Weights:/
  - Level 1 : 1
  - Level 2 : 1
  - Level 3 : 1
  - Level 4 : 1
  - Level 5 : 1
  - Level 6 : 1
  - Level 7 : 1

Peak Sum Table

No Entries in table

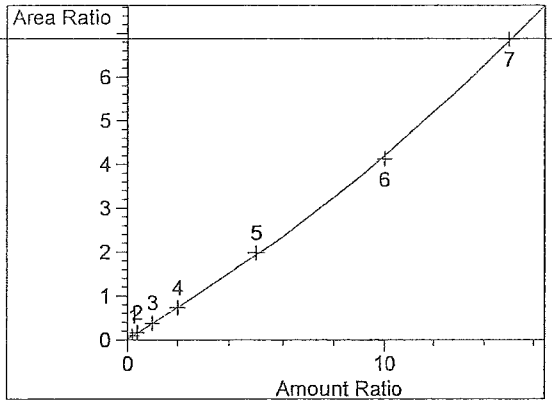
Calibration Curves



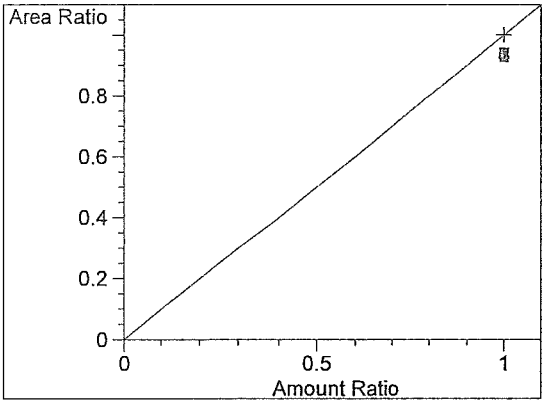
Perchlorate at exp. RT: 12.090
MSD1 83, EIC=82.7:83.7
Correlation: 0.99991
Residual Std. Dev.: 0.08487
Formula: $y = ax^2 + bx + c$
- a: 2.87739e-2
- b: 1.07712
- c: -5.23718e-3
- x: Amount Ratio
- y: Area Ratio

Calibration Level Weights:
- Level 1 : 1
- Level 2 : 0.5
- Level 3 : 0.2
- Level 4 : 0.1
- Level 5 : 0.04
- Level 6 : 0.02
- Level 7 : 0.013333

ethod C:\HPCHEM\1\METHODS\CLO4-DPR.M



CLO4-85 at exp. RT: 12.106
MSD1 85, EIC=84.7:85.7
Correlation: 0.99988
Residual Std. Dev.: 0.04548
Formula: $y = ax^2 + bx + c$
a: 7.12800e-3
b: 3.46840e-1
c: 1.42573e-2
x: Amount Ratio
y: Area Ratio
Calibration Level Weights:
Level 1 : 1
Level 2 : 0.5
Level 3 : 0.2
Level 4 : 0.1
Level 5 : 0.04
Level 6 : 0.02
Level 7 : 0.013333



CLO4-89-ISTD at exp. RT: 12.107
MSD1 89, EIC=88.7:89.7
Correlation: 1.00000
Residual Std. Dev.: 0.00000
Formula: $y = mx + b$
m: 1.00000
b: 0.00000
x: Amount Ratio
y: Area Ratio
Calibration Level Weights:
Level 1 : 1
Level 2 : 1
Level 3 : 1
Level 4 : 1
Level 5 : 1
Level 6 : 1
Level 7 : 1

Batch Report: C:\HPCHEM\1\DATA\28NOV17P\28NOV17P.B

Batch Review Method:
C:\HPCHEM\1\METHODS\CLO4-DPR.M

['#' ==> Run has not been reprocessed with Batch Review Method
'*' ==> Run has been saved with batch file]

#	*	Sample Location	Inj	SampleType	Run	Perchlorate Area	Perchlorate RT	Perchlorate Amount
	*	ICAL1@ 1.0ug/L Vial 71	1	Control	1	4.10942e4	12.029	1.02861
	*	ICAL2@ 2.0ug/L Vial 72	1	Control	2	7.74077e4	12.054	1.98725
	*	ICAL3@ 5.0ug/L Vial 73	1	Control	3	1.92985e5	12.090	5.00575
	*	ICAL4@ 10.ug/L Vial 74	1	Control	4	3.91583e5	12.084	9.57892
	*	ICAL5@ 25.ug/L Vial 75	1	Control	5	1.09763e6	12.065	25.55231
	*	ICAL6@ 50.ug/L Vial 76	1	Control	6	2.29834e6	12.065	49.83164
	*	ICAL7@ 75.ug/L Vial 77	1	Control	7	3.73021e6	12.090	74.99992
	*	ICAL Verf@10ug/L Vial 78	1	Control	8	3.83615e5	12.163	9.59533

#	*	Sample Location	Inj	SampleType	Run	CLO4-85 Area	CLO4-85 RT	CLO4-85 Amount
	*	ICAL1@ 1.0ug/L Vial 71	1	Control	1	1.56787e4	12.053	9.87106e-1
	*	ICAL2@ 2.0ug/L Vial 72	1	Control	2	2.80487e4	12.066	2.01046
	*	ICAL3@ 5.0ug/L Vial 73	1	Control	3	6.51323e4	12.106	5.05104
	*	ICAL4@ 10.ug/L Vial 74	1	Control	4	1.31325e5	12.101	9.85678
	*	ICAL5@ 25.ug/L Vial 75	1	Control	5	3.46913e5	12.084	25.58435
	*	ICAL6@ 50.ug/L Vial 76	1	Control	6	6.96156e5	12.080	49.18282
	*	ICAL7@ 75.ug/L Vial 77	1	Control	7	1.13077e6	12.106	75.33907
	*	ICAL Verf@10ug/L Vial 78	1	Control	8	1.31460e5	12.177	10.08554

#	*	Sample Location	Inj	SampleType	Run	CLO4-89-ISTD Area	CLO4-89-ISTD RT	CLO4-89-ISTD Amount
	*	ICAL1@ 1.0ug/L Vial 71	1	Control	1	1.88880e5	12.050	5.00000
	*	ICAL2@ 2.0ug/L Vial 72	1	Control	2	1.81109e5	12.078	5.00000
	*	ICAL3@ 5.0ug/L Vial 73	1	Control	3	1.75128e5	12.110	5.00000
	*	ICAL4@ 10.ug/L Vial 74	1	Control	4	1.80962e5	12.109	5.00000
	*	ICAL5@ 25.ug/L Vial 75	1	Control	5	1.75597e5	12.084	5.00000
	*	ICAL6@ 50.ug/L Vial 76	1	Control	6	1.69148e5	12.086	5.00000
	*	ICAL7@ 75.ug/L Vial 77	1	Control	7	1.64867e5	12.107	5.00000
	*	ICAL Verf@10ug/L Vial 78	1	Control	8	1.76961e5	12.181	5.00000

*** End of Report ***

equence: C:\HPCHEM\1\SEQUENCE\CLO4\2017\NOV\28NOV17P.S

Sequence Table:

Method and Injection Info Part:

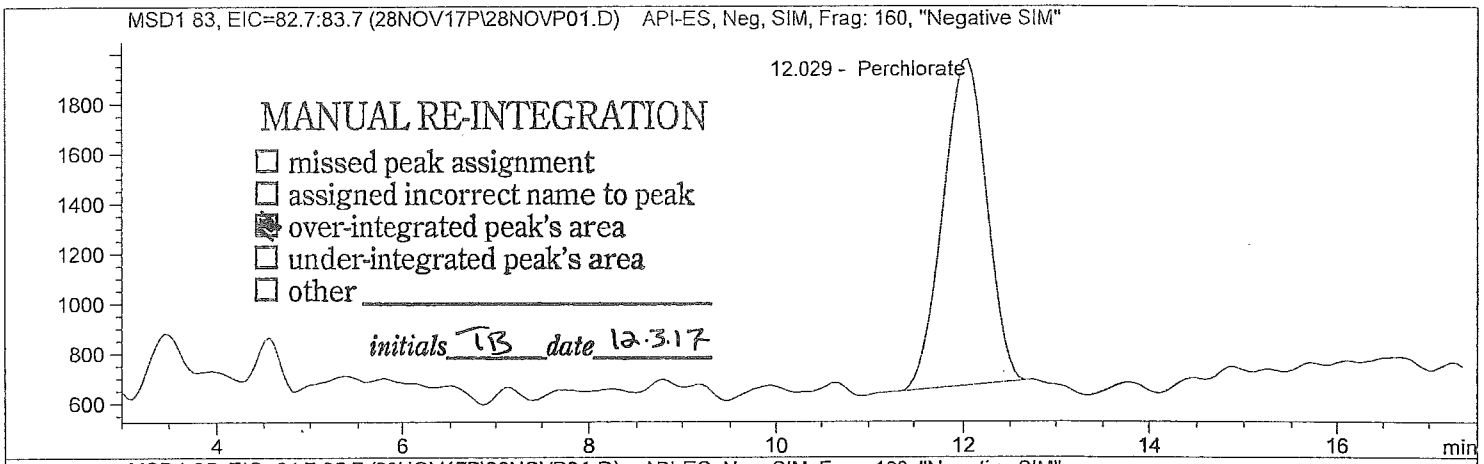
Line	Location	SampleName	Method	Inj	SampleType	InjVolume	DataFile
1	Vial 71	ICAL1@ 1.0ug/L	CLO4-DOD	1	Ctrl Samp		
2	Vial 72	ICAL2@ 2.0ug/L	CLO4-DOD	1	Ctrl Samp		
3	Vial 73	ICAL3@ 5.0ug/L	CLO4-DOD	1	Ctrl Samp		
4	Vial 74	ICAL4@ 10.ug/L	CLO4-DOD	1	Ctrl Samp		
5	Vial 75	ICAL5@ 25.ug/L	CLO4-DOD	1	Ctrl Samp		
6	Vial 76	ICAL6@ 50.ug/L	CLO4-DOD	1	Ctrl Samp		
7	Vial 77	ICAL7@ 75.ug/L	CLO4-DOD	1	Ctrl Samp		
8	Vial 78	ICAL Verf@10ug/L	CLO4-DOD	1	Ctrl Samp		

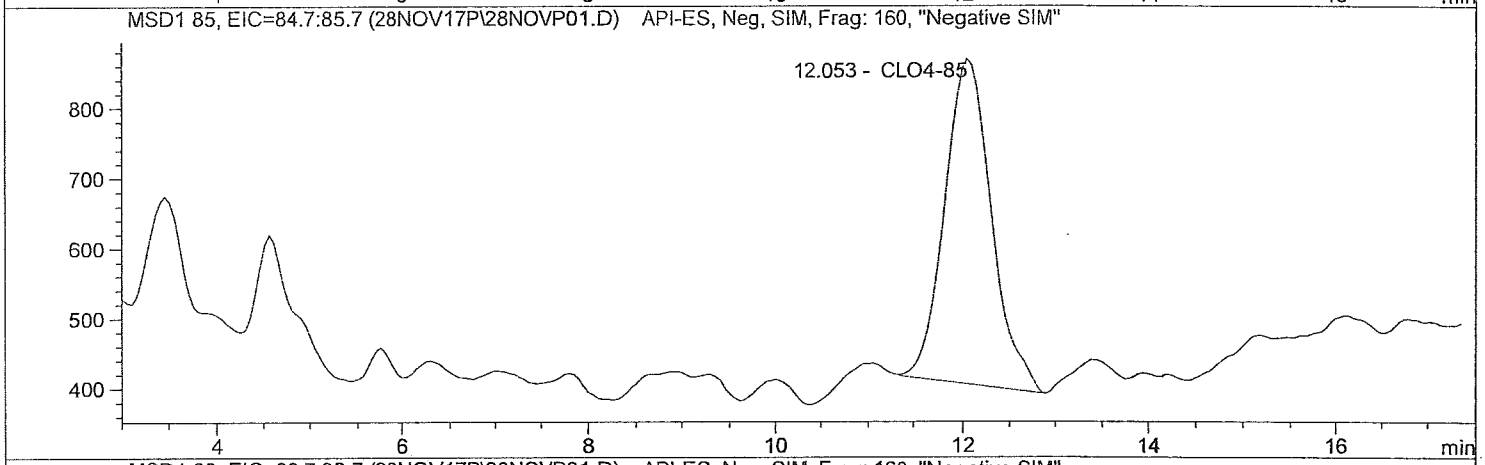
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP01.D Sample Name: ICAL1@ 1.0ug/L

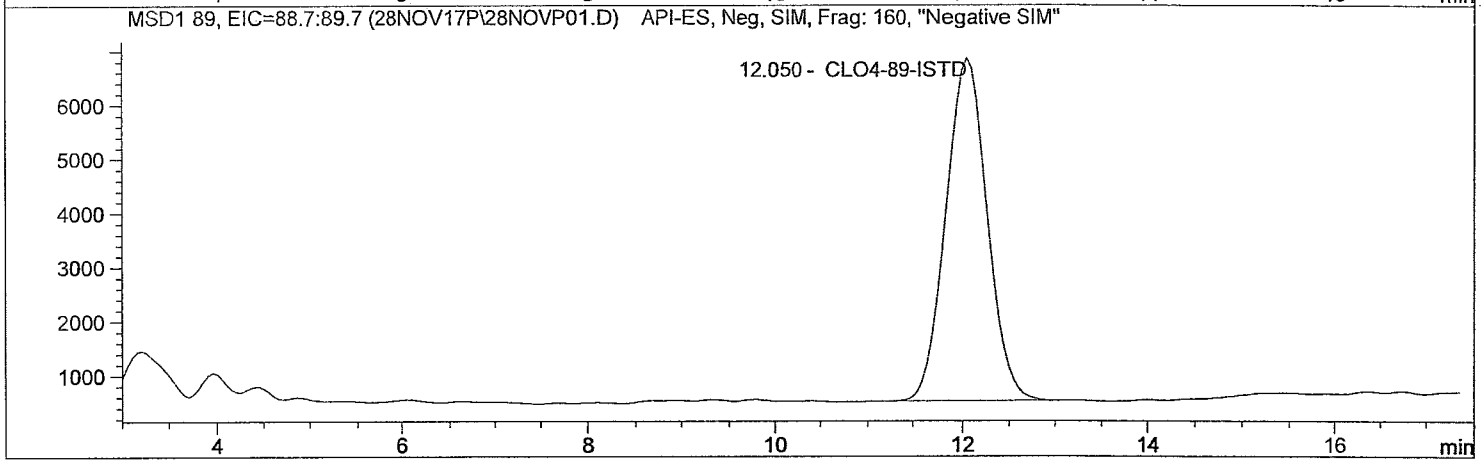
Injection Date:	11/28/2017 09:08:10	Seq Line:	1
Sample Name:	ICAL1@ 1.0ug/L	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP01.D Sample Name: ICAL1@ 1.0ug/L

Injection Date:	11/28/2017 09:08:10	Seq Line:	1
Sample Name:	ICAL1@ 1.0ug/L	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.029	MM	41094.2	1.0286	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.053	BBA	15678.7	0.9871	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.050	BBA	188880.3	5.0000	CLO4-89-ISTD

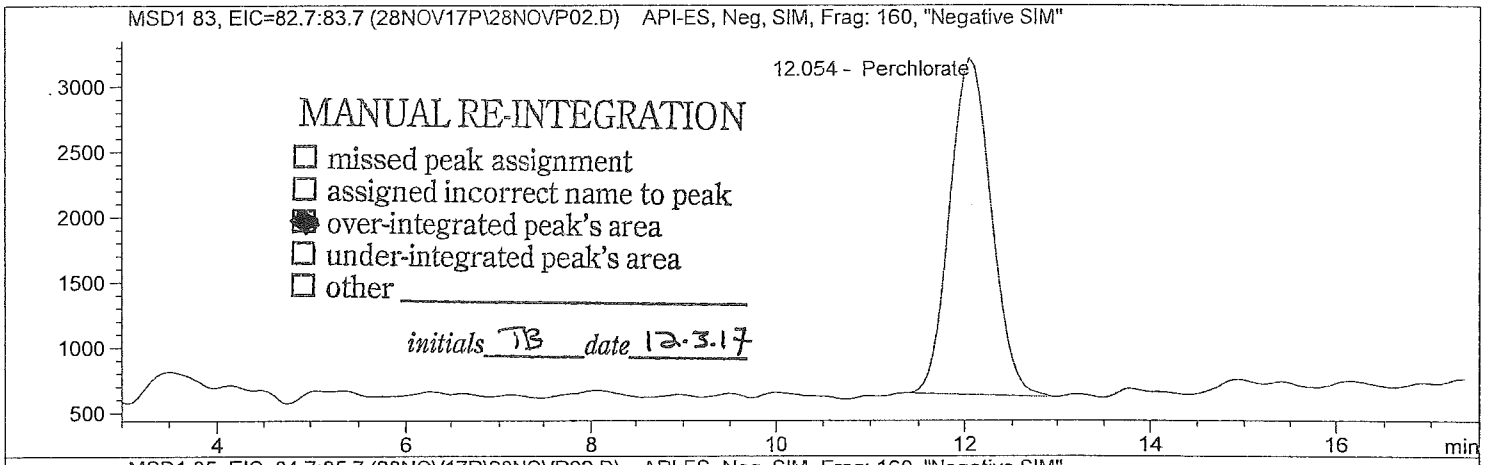
*** End of Report ***

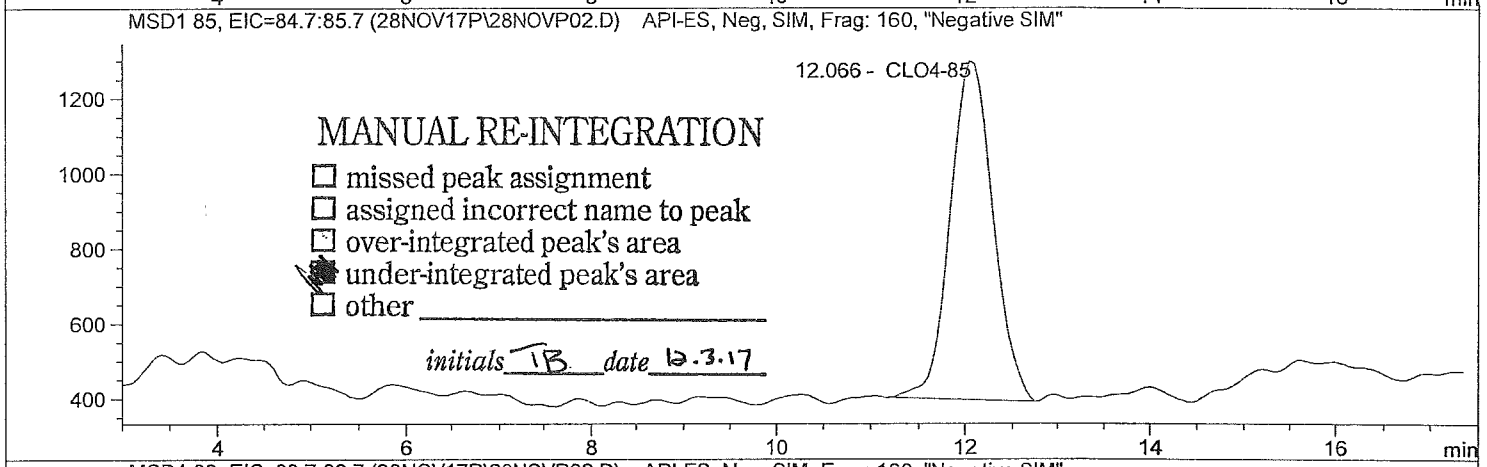
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP02.D Sample Name: ICAL2@ 2.0ug/L

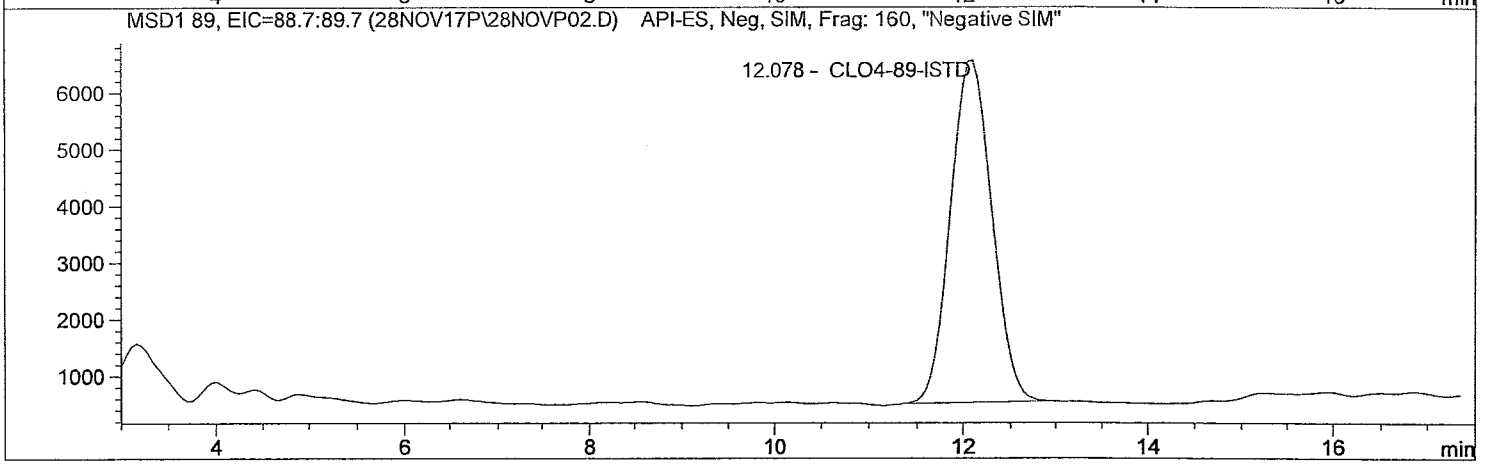
Injection Date:	11/28/2017 09:33:49	Seq Line:	2
Sample Name:	ICAL2@ 2.0ug/L	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP02.D Sample Name: ICAL2@ 2.0ug/L

Injection Date:	11/28/2017 09:33:49	Seq Line:	2
Sample Name:	ICAL2@ 2.0ug/L	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	2.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.054	MM	77407.7	1.9872	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.066	MM	28048.7	2.0105	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.078	PBA	181109.4	5.0000	CLO4-89-ISTD

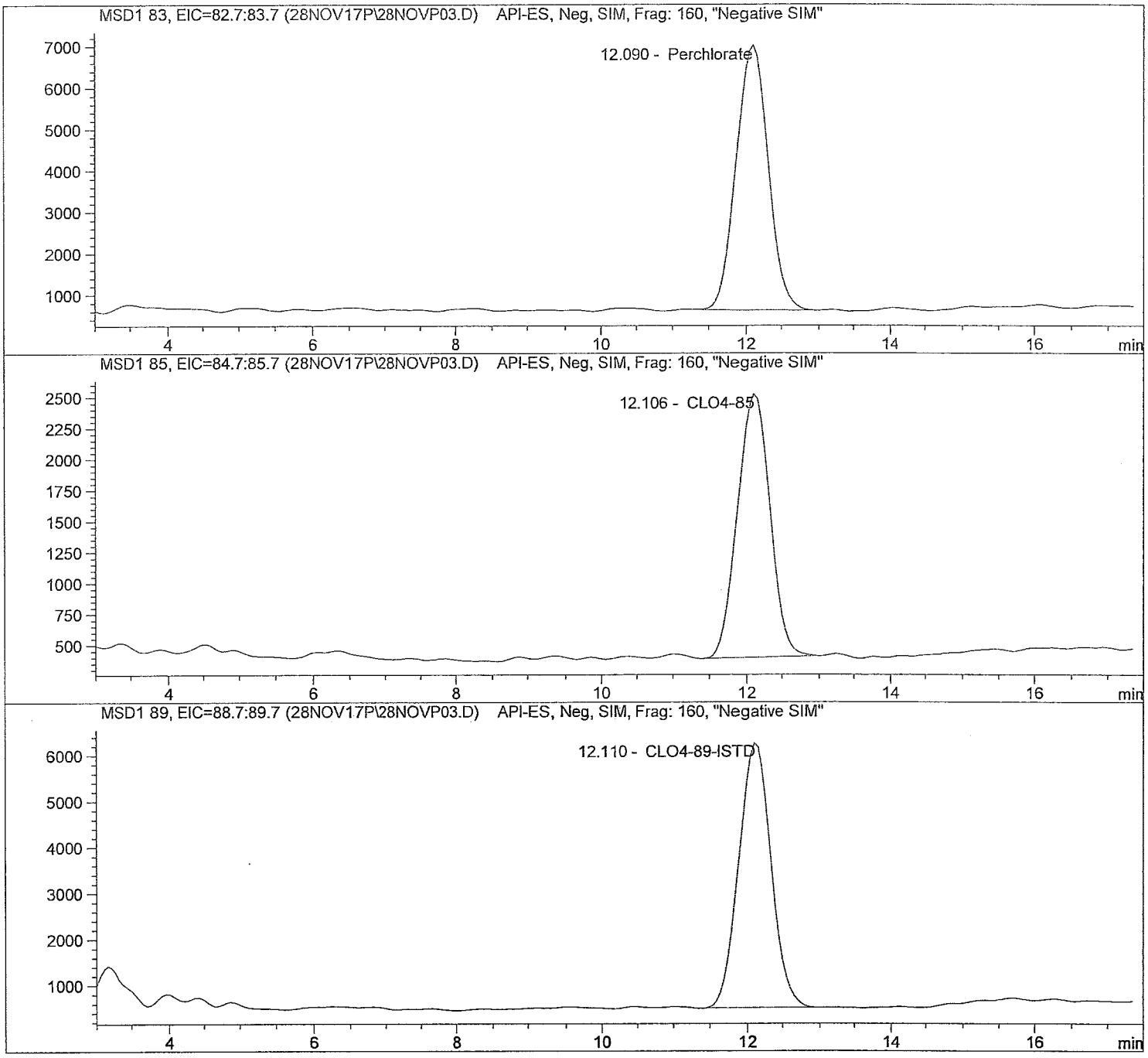
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP03.D Sample Name: ICAL3@ 5.0ug/L

Injection Date:	11/28/2017 09:53:00	Seq Line:	3
Sample Name:	ICAL3@ 5.0ug/L	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP03.D Sample Name: ICAL3@ 5.0ug/L

Injection Date:	11/28/2017 09:53:00	Seq Line:	3
Sample Name:	ICAL3@ 5.0ug/L	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Wed, 29. Nov. 2017,08:02:06 am
Multiplier: 1.000000
Dilution: 1.000000
Sample Amount: 5.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.090	BBA	192984.6	5.0058	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.106	PBA	65132.3	5.0510	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.110	PBA	175128.5	5.0000	CLO4-89-ISTD

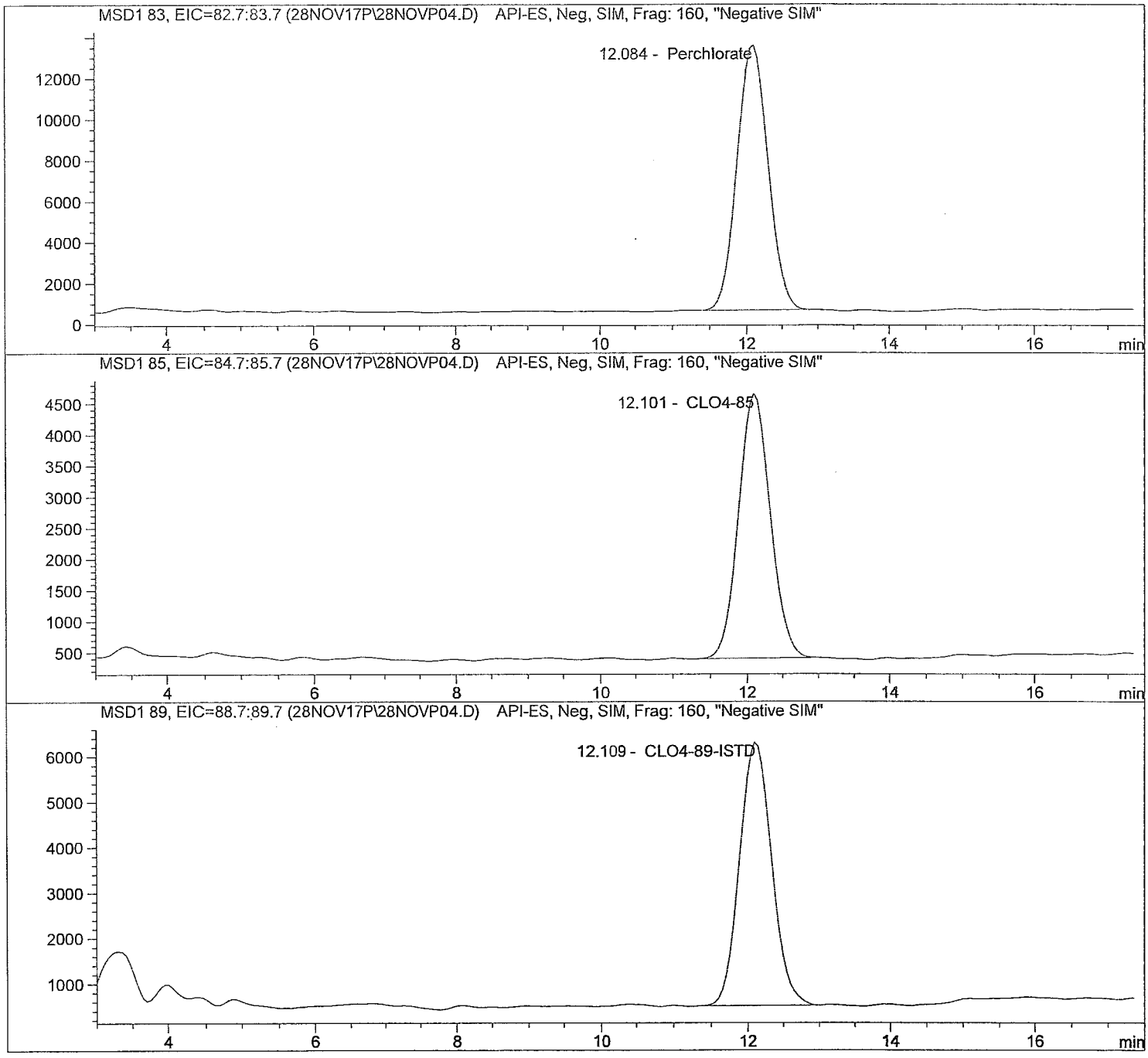
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP04.D Sample Name: ICAL4@ 10.ug/L

Injection Date:	11/28/2017 10:12:13	Seq Line:	4
Sample Name:	ICAL4@ 10.ug/L	Location:	Vial 74
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP04.D Sample Name: ICAL4@ 10.ug/L

Injection Date:	11/28/2017 10:12:13	Seq Line:	4
Sample Name:	ICAL4@ 10.ug/L	Location:	Vial 74
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Wed, 29. Nov. 2017,08:02:06 am
Multiplier: 1.000000
Dilution: 1.000000
Sample Amount: 10.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.084	BBA	391582.9	9.5789	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.101	PBA	131324.7	9.8568	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.109	PBA	180962.1	5.0000	CLO4-89-ISTD

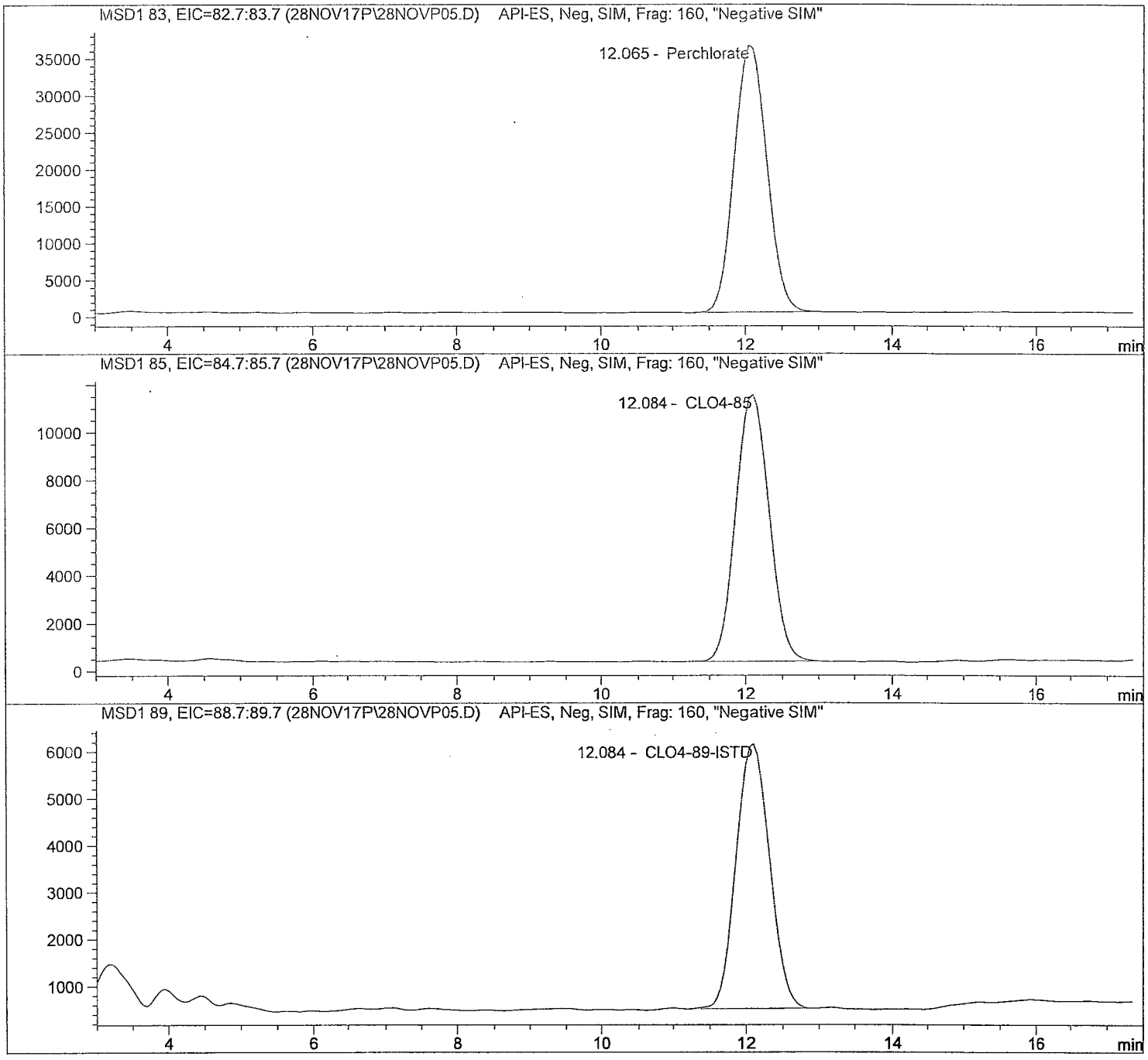
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP05.D Sample Name: ICAL5@ 25.ug/L

Injection Date:	11/28/2017 10:31:23	Seq Line:	5
Sample Name:	ICAL5@ 25.ug/L	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP05.D Sample Name: ICAL5@ 25.ug/L

Injection Date:	11/28/2017 10:31:23	Seq Line:	5
Sample Name:	ICAL5@ 25.ug/L	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	25.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.065	PBA	1097625.1	25.5523	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.084	PBA	346912.7	25.5843	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.084	BBA	175597.1	5.0000	CLO4-89-ISTD

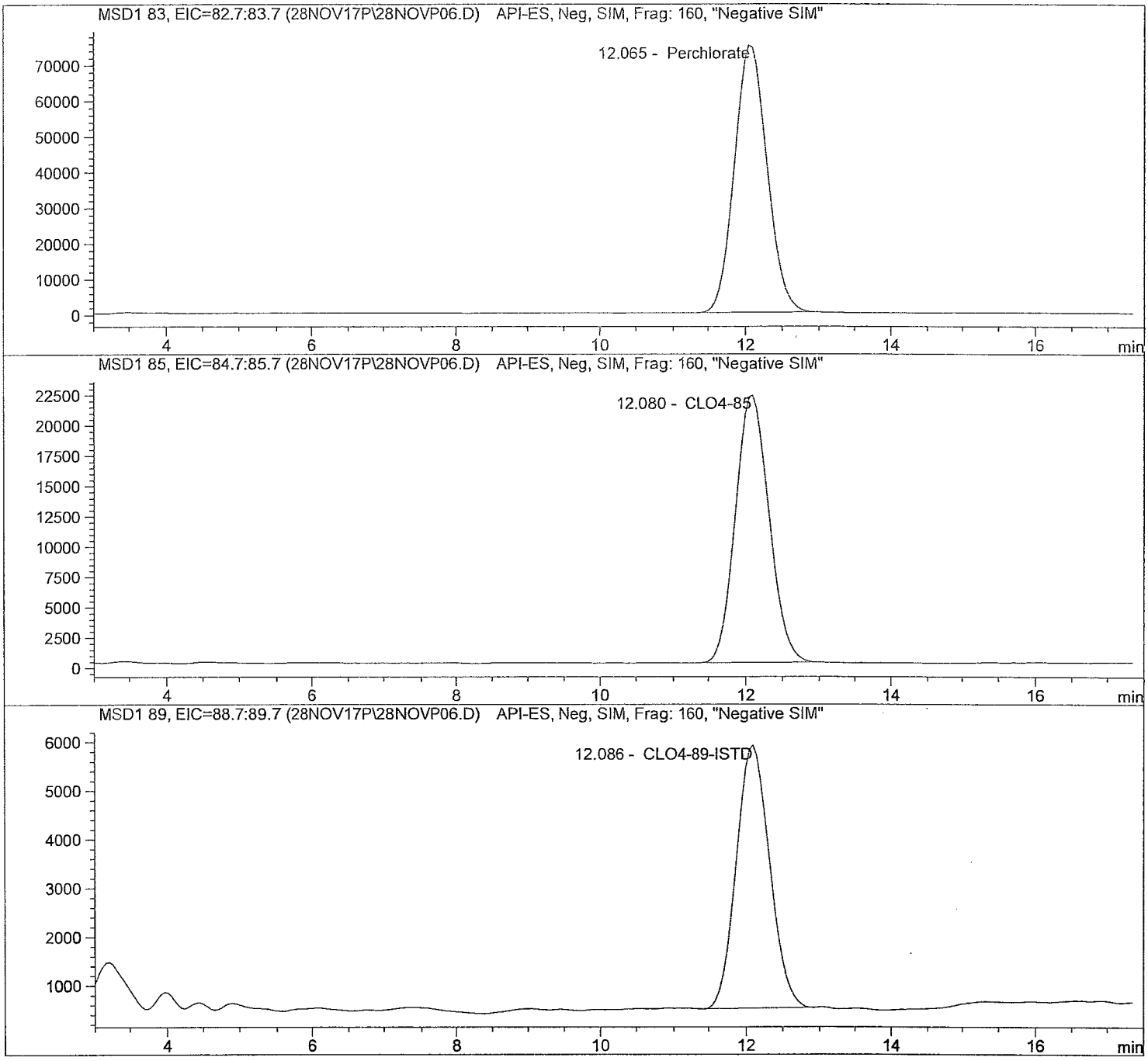
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP06.D Sample Name: ICAL6@ 50.ug/L

Injection Date:	11/28/2017 10:50:33	Seq Line:	6
Sample Name:	ICAL6@ 50.ug/L	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP06.D Sample Name: ICAL6@ 50.ug/L

Injection Date:	11/28/2017 10:50:33	Seq Line:	6
Sample Name:	ICAL6@ 50.ug/L	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	50.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.065	BBA	2298336.2	49.8316	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.080	PBA	696155.7	49.1828	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.086	PBA	169148.1	5.0000	CLO4-89-ISTD

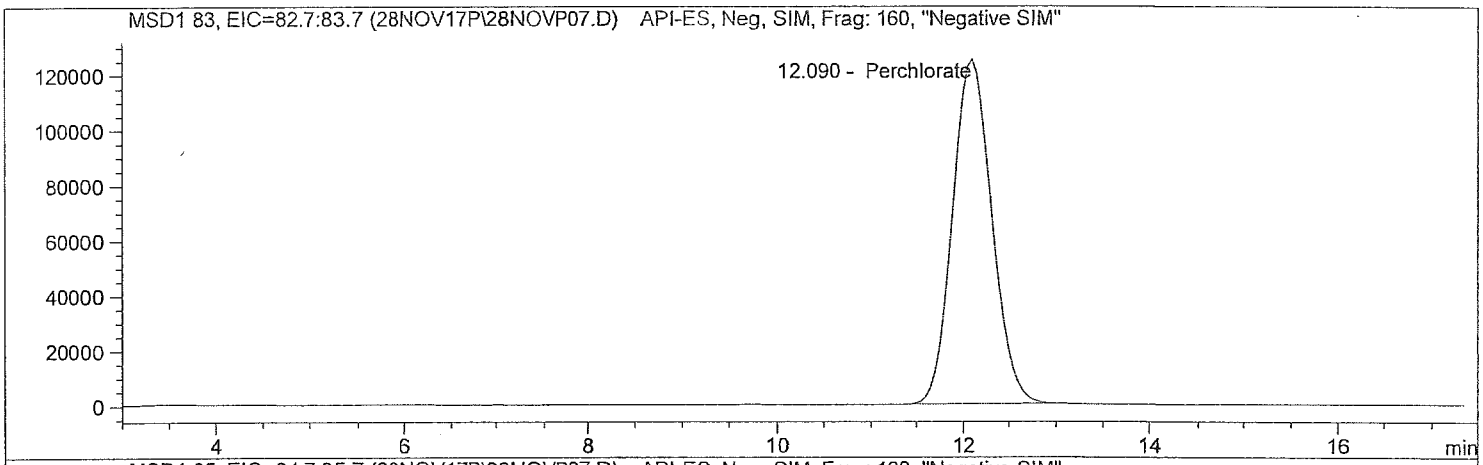
*** End of Report ***

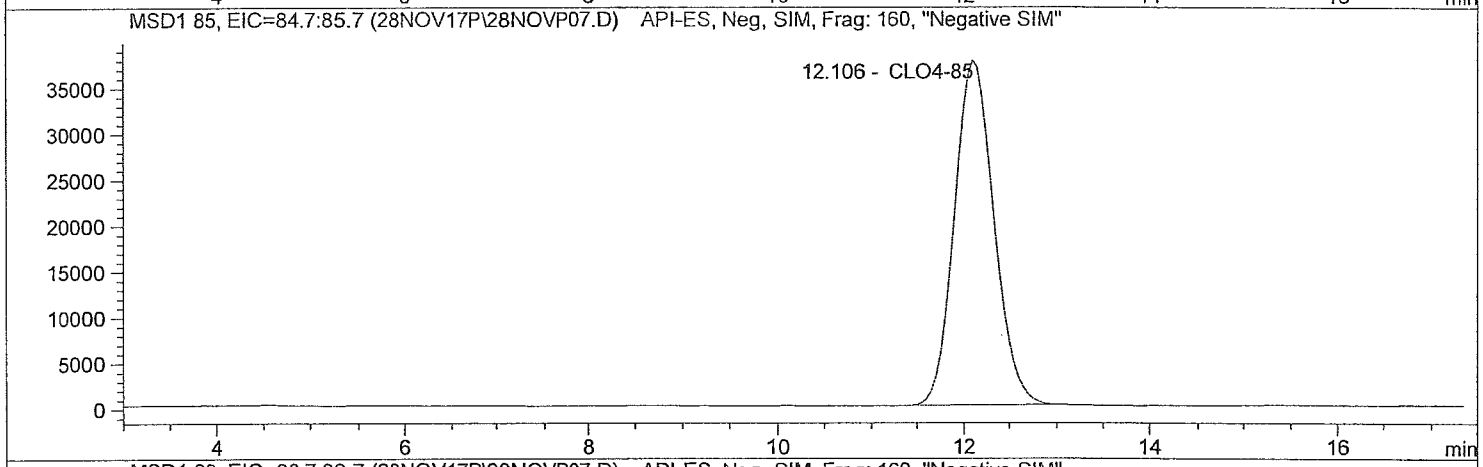
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP07.D Sample Name: ICAL7@ 75.ug/L

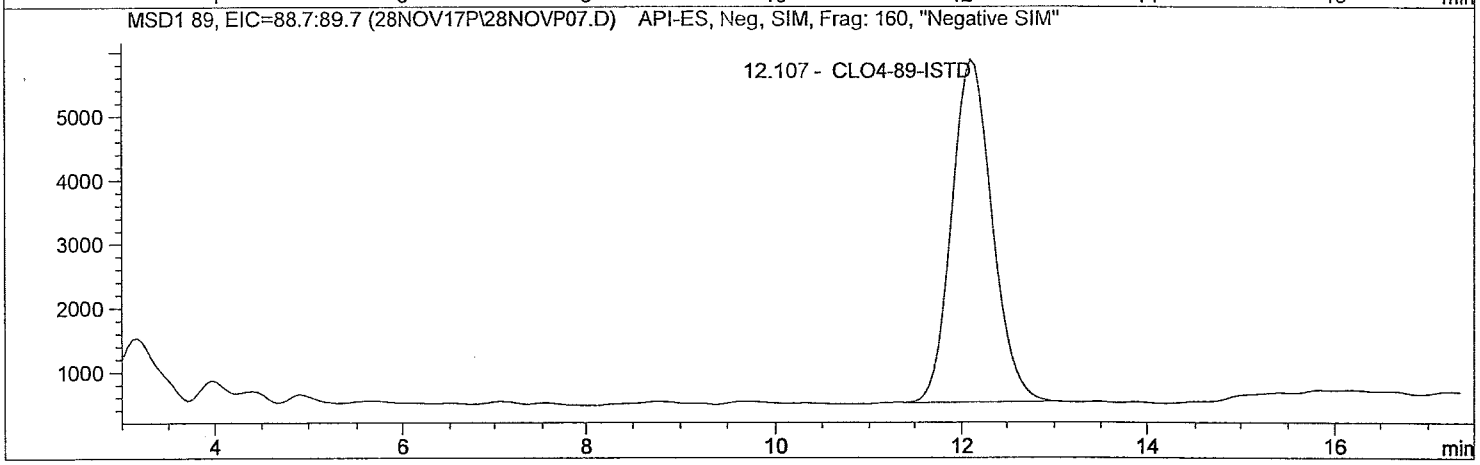
Injection Date:	11/28/2017 11:09:43	Seq Line:	7
Sample Name:	ICAL7@ 75.ug/L	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP07.D Sample Name: ICAL7@ 75.ug/L

Injection Date:	11/28/2017 11:09:43	Seq Line:	7
Sample Name:	ICAL7@ 75.ug/L	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Wed, 29. Nov. 2017,08:02:06 am
Multiplier: 1.000000
Dilution: 1.000000
Sample Amount: 75.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.090	PBA	3730211.3	74.9999	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.106	PBA	1130772.0	75.3391	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.107	BBA	164866.7	5.0000	CLO4-89-ISTD

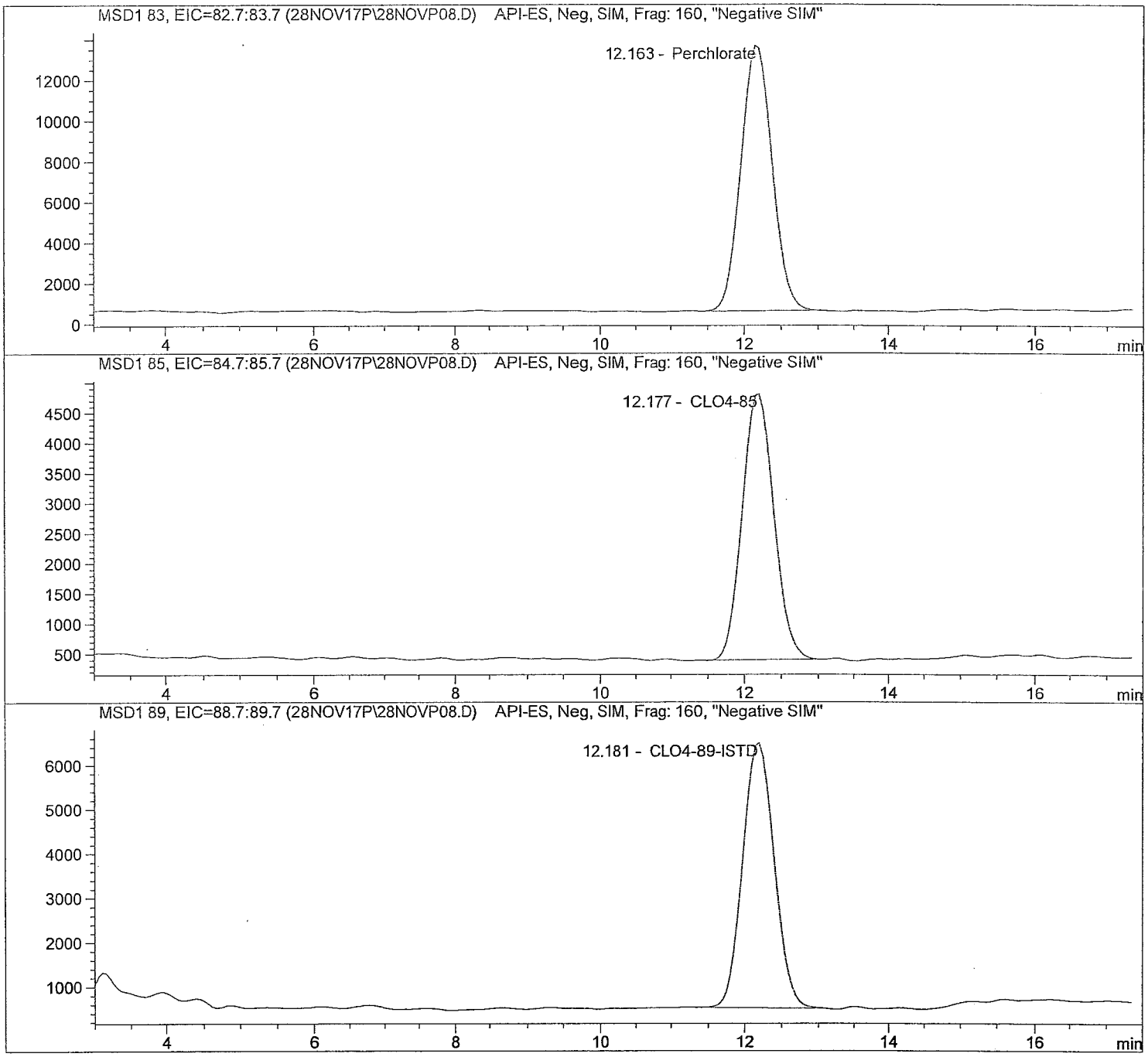
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP08.D Sample Name: ICAL Verf@10ug/L

Injection Date:	11/28/2017 11:28:53	Seq Line:	8
Sample Name:	ICAL Verf@10ug/L	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP08.D Sample Name: ICAL Verf@10ug/L

Injection Date:	11/28/2017 11:28:53	Seq Line:	8
Sample Name:	ICAL Verf@10ug/L	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	10.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.163	PBA	383615.2	9.5953	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.177	PBA	131459.5	10.0855	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.181	BBA	176961.2	5.0000	CLO4-89-ISTD

*** End of Report ***

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data

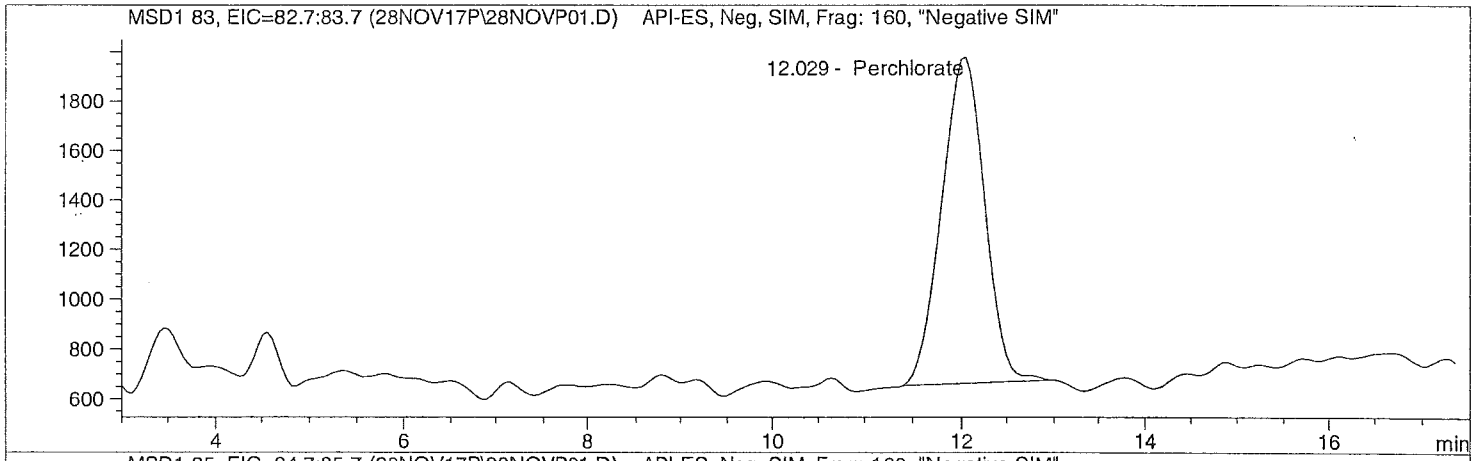
Unmodified

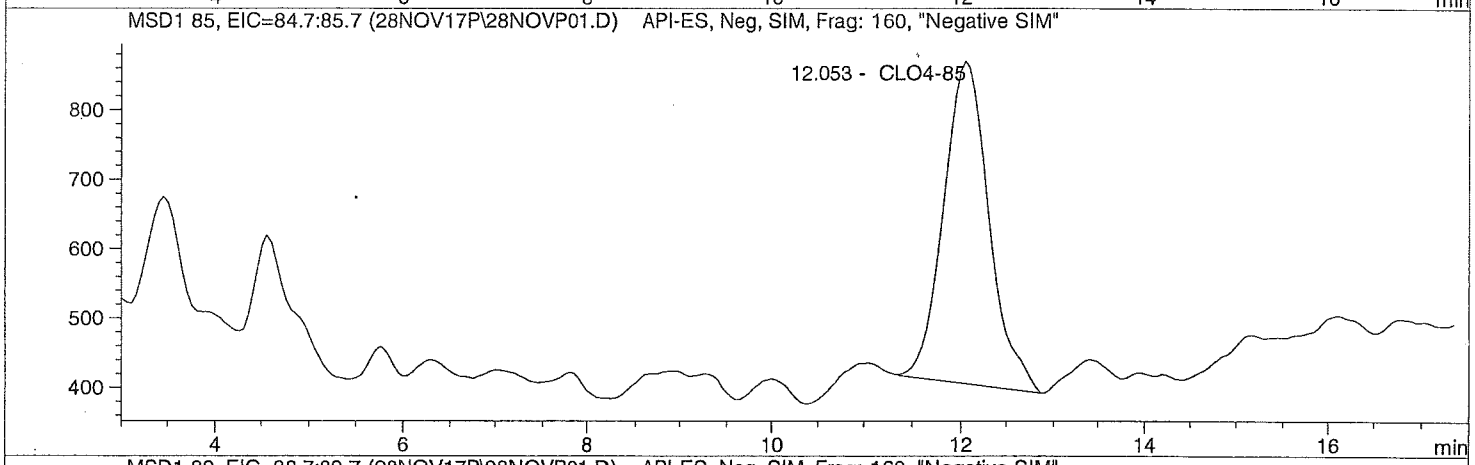
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP01.D Sample Name: ICAL1@ 1.0ug/L

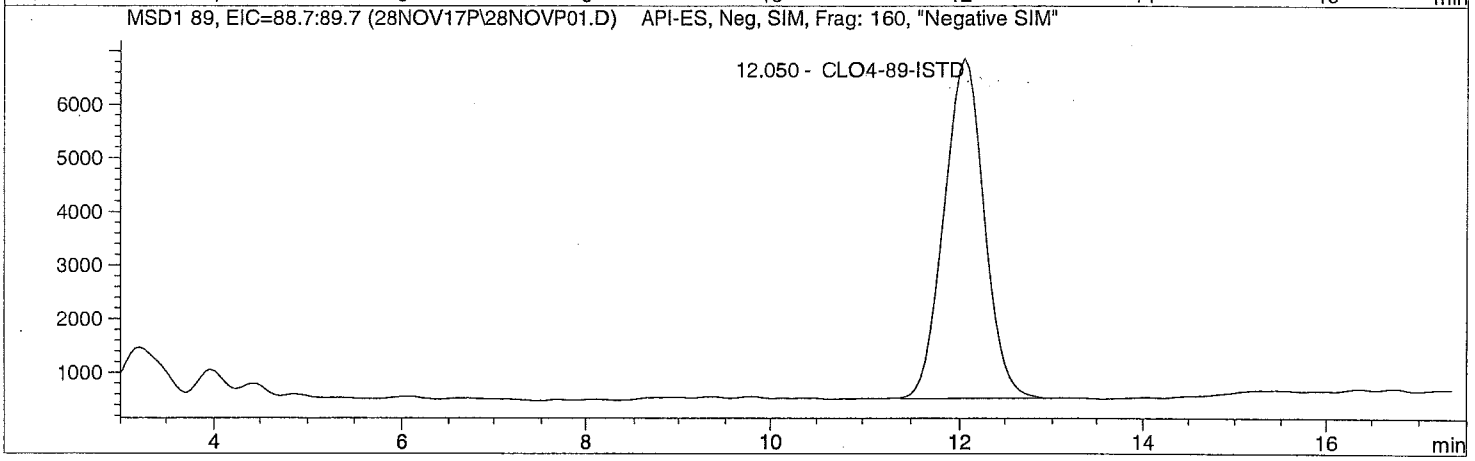
Injection Date:	11/28/2017 09:08:10	Seq Line:	1
Sample Name:	ICAL1@ 1.0ug/L	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP01.D Sample Name: ICAL1@ 1.0ug/L

Injection Date:	11/28/2017 09:08:10	Seq Line:	1
Sample Name:	ICAL1@ 1.0ug/L	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.029	BBA	42017.4	1.0510	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.053	BBA	15678.7	0.9871	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.050	BBA	188880.3	5.0000	CLO4-89-ISTD

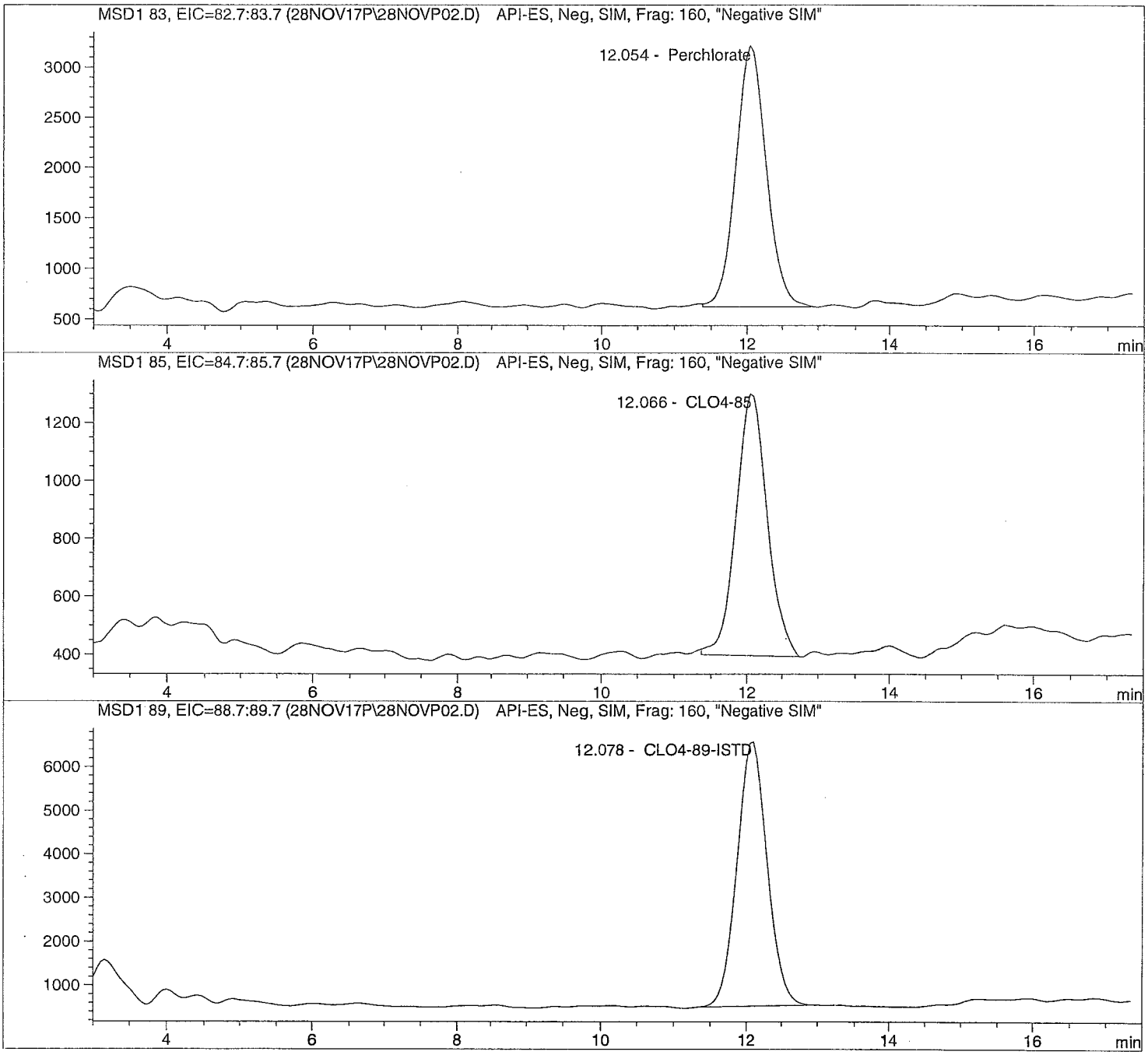
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP02.D Sample Name: ICAL2@ 2.0ug/L

Injection Date:	11/28/2017 09:33:49	Seq Line:	2
Sample Name:	ICAL2@ 2.0ug/L	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP02.D Sample Name: ICAL2@ 2.0ug/L

Injection Date:	11/28/2017 09:33:49	Seq Line:	2
Sample Name:	ICAL2@ 2.0ug/L	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	2.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.054	BBA	78519.1	2.0151	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.066	BBA	28009.6	2.0074	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.078	PBA	181109.4	5.0000	CLO4-89-ISTD

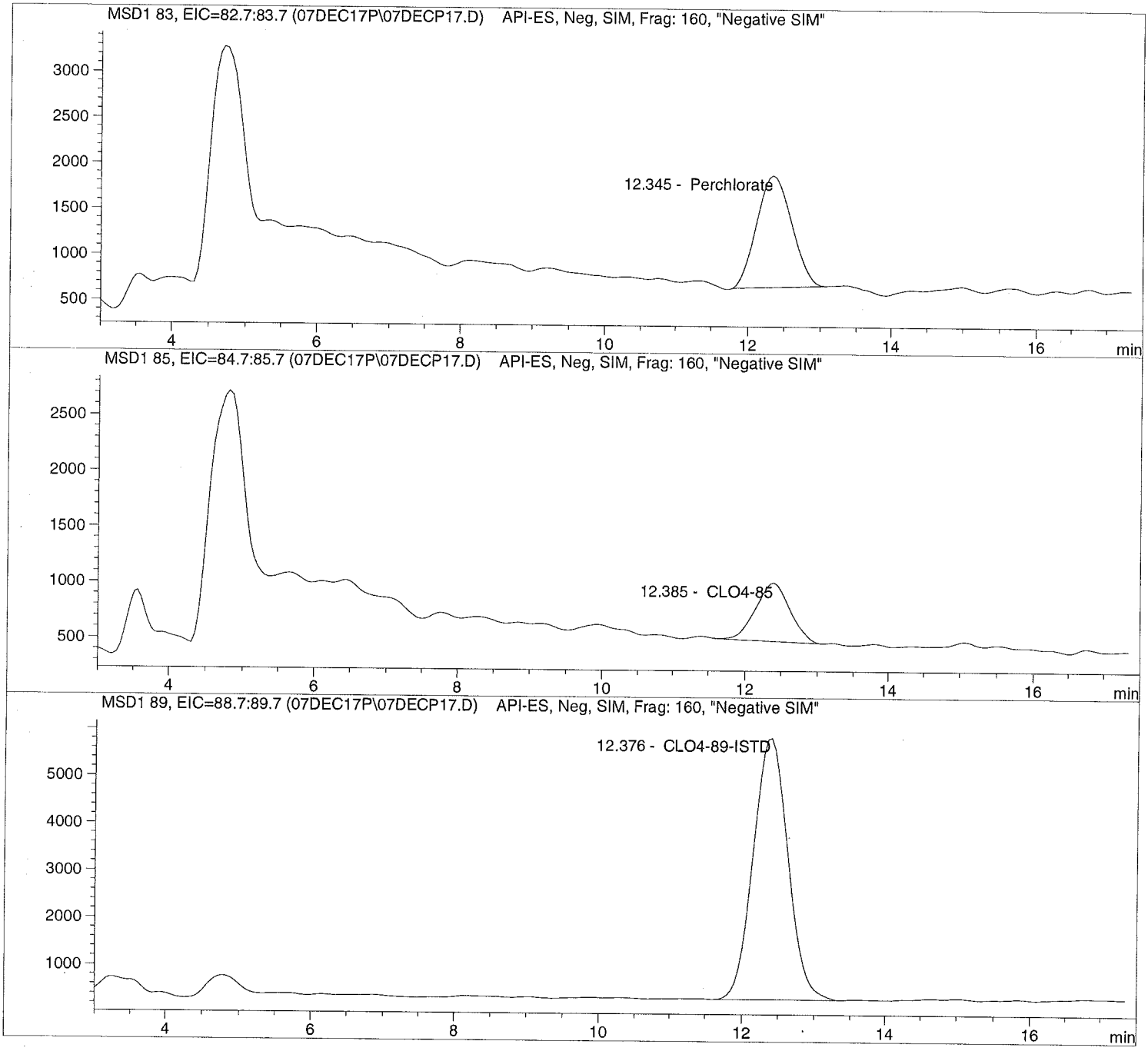
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP17.D Sample Name: 577686 LODV@1.

Injection Date:	12/07/2017 13:52:07	Seq Line:	17
Sample Name:	577686 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP17.D Sample Name: 577686 LODV@1.

Injection Date:	12/07/2017 13:52:07	Seq Line:	17
Sample Name:	577686 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.345	PBA	41109.0	1.0507	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.385	BBA	17417.8	1.1474	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.376	PBA	184854.0	5.0000	CLO4-89-ISTD

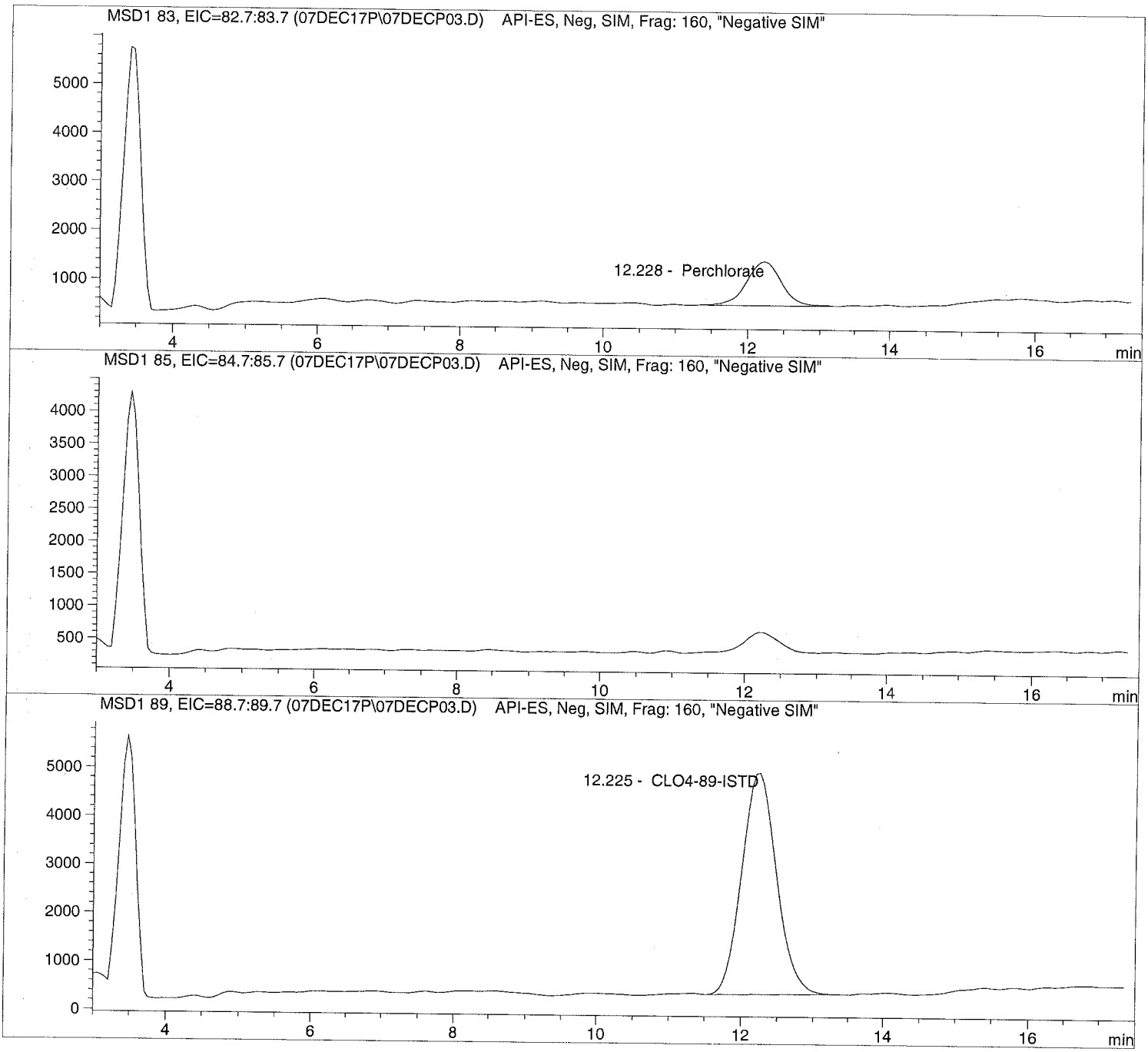
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP03.D Sample Name: 577682 ICS@1.

Injection Date:	12/07/2017 09:22:29	Seq Line:	3
Sample Name:	577682 ICS@1.	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\07DEC17P\07DECP03.D Sample Name: 577682 ICS@1.

Injection Date:	12/07/2017 09:22:29	Seq Line:	3
Sample Name:	577682 ICS@1.	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 12/3/2017 11:06:36

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 29. Nov. 2017,08:02:06 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.228	BBA	29829.2	0.9271	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
12.225	PBA	152600.9	5.0000	CLO4-89-ISTD

*** End of Report ***

NOVEMBER 2018 LABORATORY ANALYTICAL REPORT

10450 Stancliff Rd. Suite 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887
www.alsglobal.com

WorkOrder: HS18110500

LHAAP / Site 001

Bhate Environmental Associates, Inc.

Marcia Olive
445 Union Blvd Ste 129
Lakewood CO 80228

26-Nov-2018

10450 Stancliff Rd. Suite 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887

November 26, 2018

Marcia Olive
Bhate Environmental Associates, Inc.
445 Union Blvd Ste 129
Lakewood, CO 80228

Work Order: **HS18110500**

Laboratory Results for: **LHAAP / Site 001**

Dear Marcia,

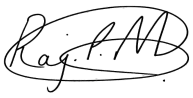
ALS Environmental received 7 sample(s) on Nov 08, 2018 for the analysis presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested. Results are expressed as "as received" unless otherwise noted.

QC sample results for this data met EPA or laboratory specifications except as noted in the Case Narrative or as noted with qualifiers in the QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained by ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

If you have any questions regarding this report, please feel free to call me.

Sincerely,



Generated By: JUMOKE.LAWAL
RJ Modashia
Project Manager

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Work Order: HS18110500

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18110500-01	27WW03_110618	Water		06-Nov-2018 13:00	08-Nov-2018 08:40	☐
HS18110500-02	27WW04_110618	Water		06-Nov-2018 13:55	08-Nov-2018 08:40	☐
HS18110500-03	27WW04_110618a	Water		06-Nov-2018 13:55	08-Nov-2018 08:40	☐
HS18110500-04	131_110618	Water		06-Nov-2018 14:10	08-Nov-2018 08:40	☐
HS18110500-05	132_110618	Water		06-Nov-2018 16:00	08-Nov-2018 08:40	☐
HS18110500-06	27WW01_110718	Water		06-Nov-2018 11:20	08-Nov-2018 08:40	☐
HS18110500-07	27WW02_110718	Water		06-Nov-2018 12:20	08-Nov-2018 08:40	☐

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Work Order:

CASE NARRATIVE

Work Order Comments

- The analysis for Perchlorate was subcontracted to ALS Salt Lake City, UT. Final report attached.

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Sample ID: 27WW03_110618
Collection Date: 06-Nov-2018 13:00

ANALYTICAL REPORT
WorkOrder:HS18110500
Lab ID:HS18110500-01
Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	26-Nov-2018 16:43

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Sample ID: 27WW04_110618
Collection Date: 06-Nov-2018 13:55

ANALYTICAL REPORT
WorkOrder:HS18110500
Lab ID:HS18110500-02
Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	26-Nov-2018 16:43

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Sample ID: 27WW04_110618a
Collection Date: 06-Nov-2018 13:55

ANALYTICAL REPORT
WorkOrder:HS18110500
Lab ID:HS18110500-03
Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	26-Nov-2018 16:43

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Sample ID: 131_110618
Collection Date: 06-Nov-2018 14:10

ANALYTICAL REPORT
WorkOrder:HS18110500
Lab ID:HS18110500-04
Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	26-Nov-2018 16:43

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Sample ID: 132_110618
Collection Date: 06-Nov-2018 16:00

ANALYTICAL REPORT
WorkOrder:HS18110500
Lab ID:HS18110500-05
Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	26-Nov-2018 16:43

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Sample ID: 27WW01_110718
Collection Date: 06-Nov-2018 11:20

ANALYTICAL REPORT
WorkOrder:HS18110500
Lab ID:HS18110500-06
Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	26-Nov-2018 16:43

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
Sample ID: 27WW02_110718
Collection Date: 06-Nov-2018 12:20

ANALYTICAL REPORT
WorkOrder:HS18110500
Lab ID:HS18110500-07
Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		**Method:NA**						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	26-Nov-2018 16:43

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
WorkOrder: HS18110500

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R328052	**Test Name :** SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)	**Matrix:** Water				
HS18110500-01	27WW03_110618	06 Nov 2018 13:00			26 Nov 2018 16:43	1
HS18110500-02	27WW04_110618	06 Nov 2018 13:55			26 Nov 2018 16:43	1
HS18110500-03	27WW04_110618a	06 Nov 2018 13:55			26 Nov 2018 16:43	1
HS18110500-04	131_110618	06 Nov 2018 14:10			26 Nov 2018 16:43	1
HS18110500-05	132_110618	06 Nov 2018 16:00			26 Nov 2018 16:43	1
HS18110500-06	27WW01_110718	06 Nov 2018 11:20			26 Nov 2018 16:43	1
HS18110500-07	27WW02_110718	06 Nov 2018 12:20			26 Nov 2018 16:43	1

ALS Houston, US Date: 26-Nov-18

Client: Bhate Environmental Associates, Inc.
Project: LHAAP / Site 001
WorkOrder: **HS18110500**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL/SDL

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitaion Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

CERTIFICATIONS,ACCREDITATIONS & LICENSES

Agency	Number	Expire Date
North Carolina	624-2018	31-Dec-2018
Arkansas	88-0356	27-Mar-2019
Texas	T10470231-18-21	30-Apr-2019
North Dakota	R193 2018-2019	30-Apr-2019
Illinois	004438	29-Jun-2019
Louisiana	03087	30-Jun-2019
Dept of Defense	ANAB L2231	22-Dec-2018
Kentucky	123043 - 2018	30-Apr-2019
Kansas	E-10352 2018-2019	31-Jul-2019
Oklahoma	2018-156	31-Aug-2019

ALS Houston, US Date: 26-Nov-18

Sample Receipt Checklist

Client Name: Bhate Environmental
Work Order: HS18110500
Date/Time Received: **08-Nov-2018 08:40**
Received by: **JRM**

Checklist completed by: *Pablo Marinez* eSignature 9-Nov-2018 Date
Reviewed by: *RJ Modashia* eSignature 9-Nov-2018 Date

Matrices: **WATER**
Carrier name: **FedEx Priority Overnight**

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
TX1005 solids received in hermetically sealed vials?	Yes ☐	No ☐	N/A ☑
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Temperature(s)/Thermometer(s):	3.2C/2.8C UC/C	IR # 11	
Cooler(s)/Kit(s):	44402		
Date/Time sample(s) sent to storage:	11/9/18 12:30		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑
pH adjusted?	Yes ☐	No ☐	N/A ☑
pH adjusted by:			

Login Notes:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

bhate ENVIRONMENTAL ENGINEERING

1608 13th Avenue South, Suite 300
Birmingham Alabama 35205
Tel: 205-918-4000
Fax: 205-918-4050

Chain of Custody and Analytical Request

Page: _____ of _____

Project/Phase No: NWO1312.0150

COC Number(1): _____

LIMS Number: _____

Facility/Base I.D.: LHAAP

Project/Site Name: LHAAP / Site 001

Client Name:

Collected by: Scott Beesinger

Field Sample ID (30 Characters Max)	ERPIMS LOCID (35 Characters Max)	Date Collected (dd-mmm-yyyy)	Time Collected (Military) (hhmm)	Sample Depth (beginning - ending)	SA Code (2)	Sample Number (3)	Sample Matrix (4)	Number of containers	PERCHLORATE	Ambient Blank Lot Control Number	Equipment Blank Lot Control Number	Trip Blank Lot Control Number	Cooler ID
27WW03_110618		06 NOV 2018	1300	-	N		WG	1	X				
27WW04_110618		06 NOV 2018	1355	-	N		WG	1	X				
27WW04_110618_FD		06 NOV 2018	1355	-	FD		WG	1	X				
131_110618		06 NOV 2018	1410		N		WG	1	X				
132_110618		06 NOV 2018	1600		N		WG	1	X				
27WW01_110718		07 NOV 2018	1120	-	N		WG	1	X				
27WW01_110718_MS		07 NOV 2018	1120	-	MS		WG	1	X				
27WW01_110718_MSD		07 NOV 2018	1120	-	SD		WG	1	X				
27WW02_110718		07 NOV 2018	1220	-	N		WG	1	X				
				-									
				-									

HS18110500
Bhate Environmental Associates, Inc.
LHAAP / Site 001

COMMENTS:

Custody Transfers Prior to Receipt by Laboratory

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1. Scott Beesinger	11/7/18	1400	1. JM pn	11-8-18	8:40
2.			2.		
3.			3.		

Sample Delivery Details / Laboratory Receipt

Delivered Directly to Lab: _____ Shipped No.:
_____ Method of Shipment: _____
_____ Fed Ex _____ Airbill Number:
_____ Analytical Lab: ALS 10450 Stanchit Rd. Suite 210 Houston, TX 77099 (281) 530-5656
ATTN SONIA WEST Lab Recipient: Delivery Date/Time:

1.) Chain of Custody Number = date collected + custody number (e.g. 09-02-1999-01)
2.) Sample Type (SA) Codes: N = Normal Sample, TB = Trip Blank (-c) Sample, FD = Field Duplicate (-a) Samples, FR = Field Replicate (-b) Samples, EB = Equipment Blank (-d) Samples, MS = Matrix Spike, SD = Matrix Spike Duplicate, AB = Ambient Blank (-e)
3.) Sample Number: Unique sample number collected from a particular location per day. (e.g. Groundwater sample collected from MW-1 on 10/10/99 = 01, if sampled again on 10/10/99 = 02, etc.)
4.) Matrix Codes: GS = Soil Gas, WG = Groundwater, WS = Surface Water, SO = Soil, SE = Sediment, SL = Sludge, SS = Surface Soil Samples, WQ = Aqueous Blank Samples (trip, equipment, ambient, etc), SQ = Soil Blanks
5.) Sample Analysis Requested: Analytical method requested and number of containers provided for each.
6.) Quality assurance samples are assigned by date (ddmmyy) and the sample number associated with the sample (01, 02, etc) (e.g. Equipment blank collected in association with MW-1 on 10/10/99 will be designated 10109901 in the Equipment Blank Lot Control

44402 WC 3.2C IR CF -0.4

ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887

44902

CUSTODY SEAL

Date: 11/7/18 Time: 1430
Name: Scott Bossinger
Company: Bhate

Seal Broken By: PM
Date: 11/8/18

FedEx.
TRK# 0221 4380 9534 0441

THU - 08 NOV 10:30A
PRIORITY OVERNIGHT

AB SGRA 44402

77099
TX-US
IAH

Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1831619

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2171 (227900)

General Set Information: There were seven field samples in these Work Orders. The samples were analyzed for perchlorate.

Method Summary: Each sample was prepared as noted below and analyzed using an Agilent 1100 LC/MSD system in select ion monitoring (SIM) mode at m/z 83 and 85, which corresponds to the loss of one oxygen atom from the perchlorate molecule. ChemStation software was used for instrument control and data analysis. The ion ratio of m/z 83 to 85 was used to positively identify the response peak as perchlorate. Quantitation was performed using the m/z 83 peak area. An internal standard (ISTD) of ^{18}O labeled perchlorate was added to each sample to establish the perchlorate peak retention time and used in quantitation.

Sample Preparation: A 10.0mL aliquot of each sample was transferred into a 15-mL centrifuge tube. 50µL of an ^{18}O labeled perchlorate solution was added to each sample as an internal standard. The samples were then capped, vortexed, and filtered into autosampler vial using Phenex PES membrane 0.45µm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: NA

Method QC data: The method blank (LMB 628727) was less than 1/2 the CRDL. The recovery for the LCS (628726) was within acceptable parameters.

MS/MSD Analysis: MS/MSD was performed on samples 1831619007/08 (Client ID: 27WW01_110718). 5.0µl of Working Standard Solution Horizon ID 43701 was added to 10.0mL of sample preparation. The spike target was 5.µg/L. The percent recoveries and relative percent difference (RPD) were within the performance limits, except for the following. The Matrix Spike (MS - 1831619007) failed QC acceptance criteria for percent recovery. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): NA

Sample Calculation: Samples were reported in µg/L. Results were calculated in µg/L by the equation (A)x(B),

where: A = Analyte concentration from the standard curve (µg/L)
B = Dilution performed at time of analysis

Miscellaneous Comments: These samples were analyzed in accordance with the requirements found in the DOD QSM Version 5.1.1. Due to limitations of the Chemstation Software, some of the chromatographic peaks require manual integration. Manual integrations were performed for datafiles 25NOVP-03/05-09/12-14.

Thomas Bosch November 26, 2018
Analyst Date

ANALYTICAL REPORT

Report Date: November 26, 2018

RJ Modashia
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1831619**
Project ID: HS18110500
Purchase Order: HS18110500
Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
27WW03_110618	1831619001	11/06/18	11/10/18	
27WW04_110618	1831619002	11/06/18	11/10/18	
27WW04_110618a	1831619003	11/06/18	11/10/18	
131_110618	1831619004	11/06/18	11/10/18	
132_110618	1831619005	11/06/18	11/10/18	
27WW01_110718	1831619006	11/06/18	11/10/18	
27WW02_110718	1831619009	11/06/18	11/10/18	

Client QC ID *	Lab ID	Collect Date	Receive Date	Sampling Site
27WW01_110718MS	1831619007	11/06/18	11/10/18	
27WW01_110718MSD	1831619008	11/06/18	11/10/18	

***Client QC is reported as part of the Quality Control results report, if requested.**

ANALYTICAL REPORT

Workorder: 34-1831619
Client: ALS Environmental (Houston)
Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: **27WW03_110618** | Sampling Site: NA | Collected: 11/06/2018
Lab ID: 1831619001 | Media: 125 mL Nalgene | Received: 11/10/2018
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2171 (HBN: 227900) | **Percent Solid:** NA
Analyzed: 11/25/2018 13:36 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **27WW04_110618** | Sampling Site: NA | Collected: 11/06/2018
Lab ID: 1831619002 | Media: 125 mL Nalgene | Received: 11/10/2018
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2171 (HBN: 227900) | **Percent Solid:** NA
Analyzed: 11/25/2018 13:50 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **27WW04_110618a** | Sampling Site: NA | Collected: 11/06/2018
Lab ID: 1831619003 | Media: 125 mL Nalgene | Received: 11/10/2018
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2171 (HBN: 227900) | **Percent Solid:** NA
Analyzed: 11/25/2018 14:03 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **131_110618** | Sampling Site: NA | Collected: 11/06/2018
Lab ID: 1831619004 | Media: 125 mL Nalgene | Received: 11/10/2018
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2171 (HBN: 227900) | **Percent Solid:** NA
Analyzed: 11/25/2018 14:17 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

ANALYTICAL REPORT

Workorder: 34-1831619
Client: ALS Environmental (Houston)
Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: **132_110618** | Sampling Site: NA | Collected: 11/06/2018
Lab ID: 1831619005 | Media: 125 mL Nalgene | Received: 11/10/2018
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2171 (HBN: 227900) | **Percent Solid:** NA
Analyzed: 11/25/2018 14:31 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **27WW01_110718** | Sampling Site: NA | Collected: 11/06/2018
Lab ID: 1831619006 | Media: 125 mL Nalgene | Received: 11/10/2018
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2171 (HBN: 227900) | **Percent Solid:** NA
Analyzed: 11/25/2018 14:45 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	ND	1.0	2.0	4.0	1	U

Sample ID: **27WW02_110718** | Sampling Site: NA | Collected: 11/06/2018
Lab ID: 1831619009 | Media: 125 mL Nalgene | Received: 11/10/2018
Matrix: Water | Sampling Parameter: NA

Analysis Method - EPA 6850, DoD QSM

Preparation: Not Applicable
Analysis: EPA 6850, DoD QSM Water | **Instrument ID:** LCMS04
Batch: ELMS/2171 (HBN: 227900) | **Percent Solid:** NA
Analyzed: 11/25/2018 15:26 | **Report Basis:** Wet

Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	2.5	1.0	2.0	4.0	1	J

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
EPA 6850, DoD QSM	/S/ Thomas Bosch 11/26/2018 11:22	/S/ Stephen Brose 11/26/2018 13:46

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Workorder: 34-1831619
Client: ALS Environmental (Houston)
Project Manager: Kevin W. Griffiths

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body	Certificate Number	Website
Environmental	PJLA (DoD ELAP)		
	Utah (TNI)		
	Nevada		
	Oklahoma		
	Iowa		

Result Symbol Definitions

MDL = Method Detection Limit, a statistical estimate of method/media/instrument sensitivity.
RL = Reporting Limit, a verified value of method/media/instrument sensitivity.
CRDL = Contract Required Detection Limit
Reg. Limit = Regulatory Limit.
ND = Not Detected, testing result not detected above the MDL or RL.
< This testing result is less than the numerical value.
** No result could be reported, see sample comments for details.

Qualifier Symbol Definitions

U = Qualifier indicates that the analyte was not detected above the MDL.
J = Qualifier Indicates that the analyte value is between the MDL and the RL. It is also used to indicate an estimated value for tentatively identified compounds in mass spectrometry where a 1:1 response is assumed.
B = Qualifier indicates that the analyte was detected in the blank.
E = Qualifier indicates that the analyte result exceeds calibration range.
P = Qualifier indicates that the RPD between the two columns is greater than 40%.

Quality Control Sample
Batch Report

Analysis Information

Workorder: 1831619

Limits:	Client SOW/Contract Specified	**Preparation:**	NA	**Analysis:**	EPA 6850, DoD QSM
Basis:	DoD QSM	**Batch:**	NA	**Batch:**	ELMS/2171 (HBN: 227900)
		Prepared By:	NA	**Analyzed By:**	Thomas Bosch

Blank

LMB: 628727
Analyzed: 11/25/2018 13:07
Units: ug/L

Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 628728
Analyzed: 11/25/2018 13:21
Dilution: 1
Units: ug/L

Analyte	Result	Target	% Rec	QC Limits	
Perchlorate	4.69	5.00	93.8	78.8	123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1831619006	**MS:** 1831619007	**MSD:** 1831619008
Analyzed: 11/25/2018 14:45	**Analyzed:** 11/25/2018 14:59	**Analyzed:** 11/25/2018 15:12
Dilution: 1	**Dilution:** 1	**Dilution:** 1
Units: ug/L	**Units:** ug/L	**Units:** ug/L

Analyte	Result	Result	Target	% Rec		QC Limits		Result	% Rec	RPD	QC Limits	
Perchlorate	ND	3.92	5	#	78.5	78.8	123.8	3.94	78.8	0.465	0.0	20.0

Continuing Calibration Verification

CCV: 628724	**CCV:** 628729
Analyzed: 11/25/2018 12:23	**Analyzed:** 11/26/2018 10:13
Units: ug/L	**Units:** ug/L
Criteria: ± 15%	**Criteria:** ± 15%

Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	25.1	25.0	101	21.9	25.0	87.6

Interference Check Sample

ICSA: 628726
Analyzed: 11/25/2018 12:54
Units: ug/L
Criteria: ± 30%

Analyte	Result	Target	% Rec.
Perchlorate	0.857	1.00	85.7

Limit of Detection Verification

LODV: 628725	**LODV:** 628730
Analyzed: 11/25/2018 12:40	**Analyzed:** 11/26/2018 10:27
Units: ug/L	**Units:** ug/L
Criteria: ± 50%	**Criteria:** ± 50%

Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	1.00	1.00	100	0.887	1.00	88.7

Quality Control Sample
Batch Report

Analysis Information

Workorder: **1831619**

Limits:	Client SOW/Contract Specified	**Preparation:**	NA	**Analysis:**	EPA 6850, DoD QSM
Basis:	DoD QSM	**Batch:**	NA	**Batch:**	ELMS/2171 (HBN: 227900)
		Prepared By:	NA	**Analyzed By:**	Thomas Bosch

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch	/S/ Stephen Brose
11/26/2018 11:22	11/26/2018 13:46

Symbols and Definitions

* - Analyte above reporting limit or outside of control limits
▲ - Sample result is greater than 4 times the spike added
◆ - Sample and Matrix Duplicate less than 5 times the reporting limit
● - Result is above the calibration range
- The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

W 1831619

18698/#2

10450 Stancliff Rd, Ste 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887
www.alsglobal.com

Subcontract Chain of Custody

COC ID: 10201

1831619

SUBCONTRACT TO:

ALS Laboratory Group
960 West LeVoy Drive
Salt Lake City, UT 84123

Phone: +1 800 356 9135

CUSTOMER INFORMATION:

Company:	ALS Houston
Contact:	RJ Modashia
Address:	10450 Stancliff Rd, Ste 210
Phone:	+1 281 530 5656
Email:	RJ.Modashia@alsglobal.com
Alternate Contact:	Jumoke M. Lawal
Email:	jumoke.lawal@alsglobal.com

INVOICE INFORMATION:

Company:	ALS Houston
Contact:	Accounts Payable
Address:	10450 Stancliff Rd, Ste 210
Phone:	+1 281 530 5656
Reference:	HS18110500
TSR:	Danielle Winnings

	LAB SAMPLE ID / ANALYSIS REQUESTED	CLIENT SAMPLE ID	MATRIX	COLLECT DATE / DUE DATE
1.	**HS18110500-01** ✓ / SUB_Perch-6850	**27WW03_110618**	**Water**	**06 Nov 2018 13:00** / 16 Nov 2018
2.	**HS18110500-02** ✓ / SUB_Perch-6850	**27WW04_110618**	**Water**	**06 Nov 2018 13:55** / 16 Nov 2018
3.	**HS18110500-03** ✓ / SUB_Perch-6850	**27WW04_110618a**	**Water**	**06 Nov 2018 13:55** / 16 Nov 2018
4.	**HS18110500-04** ✓ / SUB_Perch-6850	**131_110618**	**Water**	**06 Nov 2018 14:10** / 16 Nov 2018
5.	**HS18110500-05** ✓ / SUB_Perch-6850	**132_110618**	**Water**	**06 Nov 2018 16:00** / 16 Nov 2018
6.	**HS18110500-06** ✓ / SUB_Perch-6850	**27WW01_110718** MS/MSD	**Water**	**06 Nov 2018 11:20** / 16 Nov 2018
7.	**HS18110500-07** ✓ / SUB_Perch-6850	**27WW02_110718**	**Water**	**06 Nov 2018 12:20** / 16 Nov 2018

Received 3 bottle for this sample 11/10/2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

Subcontract Chain of Custody

COC ID: 10201

QC Level: DOD IV (DoD Data Package)

Relinquished By:	J. Mackey	Date/Time:	11/9/18 18:00
Received By:	M Schmidt	Date/Time:	11/10/2018 9:10
Cooler ID(s):		Temperature(s):	

ALS-SALT LAKE CITY-RELATED INFORMATION REPORT (CRIR)

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

Client Name: ALS Houston

Project/Task/Site: 18311619

Date/Time of Receipt: 11/10/2018 9:10

Number of Coolers Received: 1

Condition of Coolers:	Acceptable/Unacceptable	Temperature Control:	Present/Not Included
Cooler Custody Seals:	Present/Absent/NA Intact/Broken/NA	Location Temp Taken:	Control/Between Samples
Container Custody Seals:	Present/Absent/NA Intact/Broken/NA	Are all temperatures within project specific guidelines?	Yes/No/NA
Ice Present:	Yes/No/NA Frozen/Melted/NA	VOA Headspace Present?	Yes/No/NA

pH Check Performed:								
	Metals	Yes/No/NA	Total Phenolics	Yes/No/NA	NO3/NO2	Yes/No/NA		
	Cyanide	Yes/No/NA	TPH – 418.1	Yes/No/NA	Oil & Grease	Yes/No/NA		
	Sulfide	Yes/No/NA	COD	Yes/No/NA	Total Phosphorous	Yes/No/NA		
	Ammonia	Yes/No/NA	TKN	Yes/No/NA	Gross A.B, Gamma Spec	Yes/No/NA		

Cooler Received	DCL Cooler No.	Temp.	Cooler Received	DCL Cooler No.	Temp.	Cooler Received	DCL Cooler No.	Temp.
1	C18 8921	2 °C	4	C18	°C	7	C18	°C
2	C18	°C	5	C18	°C	8	C18	°C
3	C18	°C	6	C18	°C	9	C18	°C

Taken By: M Schmitt (Signature) M Schmitth (Printed Name) 11/10/2018 (Date)

CLIENT-RELATED INFORMATION

☐ Missing Cooler	☐ Missing Samples/Bottles	☐ Incorrect Preservation	☐ Insufficient Sample Volume
☐ Cooler Conditions	☐ Broken/Leaking Samples	☐ pH Criteria Not Met	☐ Chain of Custody Problems
☐ Missing Paperwork	☐ Incorrect Bottle Type	☐ Residual Chlorine Present	☐ Other:
☐ Missing/Incorrect Bottle Labels	☐ Cooler Temperatures Out of Range	☐ Head Space in Bottles	

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

3 125 a bottle recieved for sample HS1811050000-de

Client Notified? YES ☐ NO ☐

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

ALS Project Manager: _____ (Printed Name) Returned to Sample Receipt by: _____ (Signature) Date: _____

CRIR.doc

Revised 01/01/2018

ALS Environmental
CHAIN-OF-CUSTODY

Project / Job / Task: HS18110500	Split:	Workorder ID: 1831619	Level: ENV_LVL4
Client: ALS Environmental (Houston)		Account: 8101	Type: 125Poly
Comments:			Preservatives: COOL

Item	Collect Date/Time	Sample ID	Lab ID	QC	Matrix	Containers ID(s)	Containers Count	Requested Analysis: EPA 6850_DoD QSM
1	11/06/2018 13:00	27WW03_110618	1831619001		Water	A	1	A
2	11/06/2018 13:55	27WW04_110618	1831619002		Water	A	1	A
3	11/06/2018 13:55	27WW04_110618a	1831619003		Water	A	1	A
4	11/06/2018 14:10	131_110618	1831619004		Water	A	1	A
5	11/06/2018 16:00	132_110618	1831619005		Water	A	1	A
6	11/06/2018 11:20	27WW01_110718	1831619006		Water	A	1	A
7	11/06/2018 11:20	27WW01_110718MS	1831619007	MS	Water	A	1	A
8	11/06/2018 11:20	27WW01_110718MSD	1831619008	MSD	Water	A	1	A
9	11/06/2018 12:20	27WW02_110718	1831619009		Water	A	1	A
10								

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ORIGINAL FIELD SAMPLE CHAIN-OF-CUSTODY

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Reason for Transfer / Storage Location
Warath, Julie	11/10/2018 09:10	ALS Sample Receiving	Sample Login
Julie Warath	11/12/18 1400	ISC	Storage
R.33.1	11.14.18/12:25	T.Bush	6850

SAMPLE PREPARATION / ANALYSIS CHAIN-OF-CUSTODY

Sample Prep / Analysis for: _____ Lab Notebook No.: _____

Prepared / Analyzed by: _____ Date / Time: _____

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Reason for Transfer / Storage Location

00915553

Batch Worklist

Batch: ELMS/ 2171
Rule: EPA 6850, DoD QSM Water
Created: 11/21/2018 10:07
Analyst: T. Bosch
Instrument:
Status: WP
HBN: 227900

Workorder: 1831619 [ENV_LVL4]

Pos	Lab ID	Sample ID	Prep Initial	Prep Final	Dust Weight	Type	Mx	Container	Procedure	Mgr	Expire Date	Due Date	Run Date
1	628724	CCV for HBN 227900 [ELMS/2171]				CCV	3		E685041C3Q	5311		11/26/2018	
2	628725	LODV for HBN 227900 [ELMS/2171				LODV	3		E6850..D3Q	5311		11/26/2018	
3	628726	ICS for HBN 227900 [ELMS/2171]				ICS	3		E6850..D3Q	5311		11/26/2018	
4	628727	LMB for HBN 227900 [ELMS/2171]				LMB	3		E6850Q413Q	5311		11/26/2018	
5	628728	LCS for HBN 227900 [ELMS/2171]				LCS	3		E6850Q413Q	5311		11/26/2018	
6	1831619001	27WW03_110618				SAMPLE	3	1831619001-A	E6850Q41.3	5480	12/4/2018	11/26/2018	
7	1831619002	27WW04_110618				SAMPLE	3	1831619002-A	E6850Q41.3	5480	12/4/2018	11/26/2018	
8	1831619003	27WW04_110618a				SAMPLE	3	1831619003-A	E6850Q41.3	5480	12/4/2018	11/26/2018	
9	1831619004	131_110618				SAMPLE	3	1831619004-A	E6850Q41.3	5480	12/4/2018	11/26/2018	
10	1831619005	132_110618				SAMPLE	3	1831619005-A	E6850Q41.3	5480	12/4/2018	11/26/2018	
11	1831619006	27WW01_110718				SAMPLE	3	1831619006-A	E6850Q41.3	5480	12/4/2018	11/26/2018	
12	1831619007	27WW01_110718MS				MS	3	1831619007-A	E6850Q413Q	5480		11/26/2018	
13	1831619008	27WW01_110718MSD				MSD	3	1831619008-A	E6850Q413Q	5480		11/26/2018	
14	1831619009	27WW02_110718				SAMPLE	3	1831619009-A	E6850Q41.3	5480	12/4/2018	11/26/2018	
15	628729	CCV for HBN 227900 [ELMS/2171]				CCV	3		E685041C3Q	5311		11/26/2018	
16	628730	LODV for HBN 227900 [ELMS/2171				LODV	3		E6850..D3Q	5311		11/26/2018	

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #( )'s: 1831619 (001-09)
ELMS Batch/HBN ID: 2171 (227900)
Prep Date: 11/21/2018 Analysis Date: 11/25,26/2018 Analyst: T. Bosch
Analyte: **Perchlorate** Matrix: **Water** Method: **6850**
Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\NOV\25NOV18D.s & 26NOV18D.s
Reported DL: **1.0µg/L** Reported LOD: **2.0µg/L** Reported LOQ: **4.0µg/L**

SAMPLE PREPARATION/ANALYSIS:

Water: Samples were prepared by TNB. 10.0mL of each sample was pipetted into a 15-mL centrifuge tube, and 50µL of an oxygen-18 labeled perchlorate solution was added as an internal standard. The samples were capped, vortexed, and filtered with Phenex PES membrane 0.45µm Syringe filters prior to analysis.

REAGENTS: Eluent A1: 95% ASTM Type II water (ALS)/ 5% ACN (B&J Lot AH015-4)/0.1% glacial acetic acid (JT-Baker Lot 04802).
Eluent B1: 95% ACN (B&J Lot AH015-4)/ 5% ASTM Type II water (ALS)/0.1% glacial acetic acid (JT-Baker Lot 04802).

STANDARDS: Internal Standard Spiking Solution Horizon# 43730. Dilutions of Working Standard Solution ID 43702 used for CCV's, LODV's, RLVS and IPC.

CALIBRATION CURVE: Used curve from 10/08/2018, sequence 08OCT18D.s Offline Quantitation Method: CLO4-DPR.M

INSTRUMENT CONDITIONS: Samples were analyzed with an Agilent 1100 LC/MSD system, in negative SIM mode, monitoring m/z 83, 85, and 89.
Instrument ID: LCMS04 Online Acquisition Method: CLO4-AQN.M Fragmentor: 160 Output Gain: 3 Injection Volume: 30µL
Column: KP-RPPX C8 separator, 250mm Mobile Phase: 70% Eluent A1; 30% Eluent B1

FLOW GRADIENT:

Time (min.)	Flow (mL/min)
0	0.80
5.0	0.80
5.3	0.25
10.0	0.25
10.5	0.80
12.5	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 41830 was used for LCS 628728; Target = 5.0µg/L. ASTM type II water was used for LMB 628727.

MS/MSD: MS/MSD was performed on samples 1831619007/08 (Client ID: 27WW01_110718). 5.0µl of Working Standard Solution Horizon ID 43701 was added to 10.0mL of sample preparation. Spike target = 5.0µg/L.

COMMENTS:
1) Results reported in µg/L.
2) All QC, Blank, CCV, and MS/MSD results were within method parameters, except for the following. The Matrix Spike (MS - 1831619007) failed QC acceptance criteria for percent recovery. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.
3) Sample data can be viewed at two directories within the ALS system: \\ALSLTWS013\LCMS\LCMS04\2018\NOV\HBN# or through NuGenesis\Tree\PrintData\LCMS\DefaultView.
4) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\22790-DoD-ALS-Hstn LCMS4 or through \\ALSLTWS013\DATAREVIEW\HBN#
5) Due to limitations of the Chemstation Software, some of the chromatographic peaks require manual integration. Manual integrations were performed for datafiles 25NOVP-03/05-09/12-14.

5.5 Chromatography (GC, HPLC and LC/MS) Technical Review

Note: It is the peer reviewer's responsibility to ensure that appropriate criteria are used as defined in the HORIZON PROFILE. The evaluation criteria are prioritized as per Section 2.2 of this SOP. These items must be checked for all projects. The following checklist will be completed by both the analyst and the peer reviewer and scanned into the HBN folder with the raw data.

Chromatography (GC, HPLC, LC/MS) Technical Review Criteria Batch(es)/SDG: ELMS: 2171 HBN: 227900 Sample Set IDs if Applicable: 1831619	Analyst Initials	Reviewer Initials
Calibration standards analyzed and meets criteria	TB	SB
Standards traceability checked and meets criteria	TB	SB
Standard curve coefficients evaluated and meet criteria	TB	SB
ICVs analyzed and meet acceptance criteria	TB	SB
CCVs analyzed and meet acceptance criteria	TB	SB
Method Blanks analyzed and meet acceptance criteria	TB	SB
Retention Time Windows checked	TB	SB
For method 8081A, Endrin/DDT Breakdown is checked for compliance	—	—
Surrogate recoveries checked and appropriately addressed	—	—
Method Preparation Blanks analyzed and meet acceptance criteria	TB	SB
MSs, MSDs, and/or MDs analyzed and calculations checked; applicable flags applied on QC reports; LCSs analyzed and meet acceptance criteria when performed	TB	SB
RLVS analyzed	TB	SB
Preparation and analysis hold times met	TB	SB
Preparation deviations and re-preparations noted when performed	TB	SB
Analysis deviations and re-analyses noted when performed	TB	SB
Sample dilution factors noted on reports	TB	SB
Electronic records in HBN transcription accuracy and completeness checked	TB	SB
Preparation and analysis calculations checked	TB	SB
NCRs are completed as necessary NC/CAR#	—	—
Report forms are complete and accurate	TB	SB
Manual integrations checked	TB	SB

STANDARD REPORT

Working Standard - CLO4 WRK

CLO4 WRK — **Description - 6850 WKG Std 100.ug/L**

Standard: 43702
MFG: ALS/SLC
MFG Lot: TNB: 09/18/2018
Pipette ID: Not Provided

Created By: Thomas Bosch
Create Date: 09/18/2018 02:09PM

Amount: 10 mL
Expires: 09/18/2019
Usable: Yes
Lab Lot: CLO4 WRK

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	0.1 ug/mL

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
109	ASTM H2O	ASTM Type II Water	LAB 109	9.9 mL	11/07/2025
43701	CLO4 INT	6850 Intermdt AccStd 10.ug/mL	CLO4 INT	0.1 mL	09/18/2019

STANDARD REPORT

Constituent

Stock Standard - CLO4 STOCK

CLO4 STOCK — **Description - 6850 Stock AccStd 1,000ug/mL**

Standard: 43659
MFG: AccuStandard
MFG Lot: 218065075
Part ID: IC-PER-10X-1

Created By: Thomas Bosch
Create Date: 09/17/2018 09:09AM

Amount: 100 mL
Expires: 07/25/2020
Usable: No
Lab Lot: CLO4 STOCK

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	1000 ug/mL

STANDARD REPORT

Constituent

Solvent Standard - ASTM H2O

ASTM H2O			Description - ASTM Type II Water
Standard: 109	**Created By:** ALS Support (Lims)	**Amount:** 1000 L	
MFG: DCL In House	**Create Date:** 10/06/2005 09:10AM	**Expires:** 11/07/2025	
MFG Lot: Not Provided		**Usable:** Yes	
Part ID: Not Provided		**Lab Lot:** LAB 109	

Pos.	Analyte	Name	Concentration
Solvent - Analyte(s) not applicable			

STANDARD REPORT

Constituent

Working Standard - CLO4 INT

CLO4 INT — Description - 6850 Intermdt AccStd 10.ug/mL

Standard: 43701
MFG: ALS/SLC
MFG Lot: TNB: 09/18/2018
Pipette ID: Not Provided

Created By: Thomas Bosch
Create Date: 09/18/2018 02:09PM

Amount: 10 mL
Expires: 09/18/2019
Usable: Yes
Lab Lot: CLO4 INT

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	10 ug/mL

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
109	ASTM H2O	ASTM Type II Water	LAB 109	9.9 mL	11/07/2025
43659	CLO4 STOCK	6850 Stock AccStd 1,000ug/mL	CLO4 STOCK	0.1 mL	07/25/2020

STANDARD REPORT

Working Standard - CLO4 QC WRK

CLO4 QC WRK — **Description - 6850 QC WKG STD 100ug/L**

Standard: 41831
MFG: ALS/SLC
MFG Lot: TNB: 05/09/2018
Pipette ID: Not Provided

Created By: Thomas Bosch
Create Date: 05/09/2018 10:05AM

Amount: 10 mL
Expires: 05/09/2019
Usable: Yes
Lab Lot: CLO4 QC WRK 100.ug/L

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	100 ug/L

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
109	ASTM H2O	ASTM Type II Water	LAB 109	9.9 mL	11/07/2025
41830	CLO4 QC INT	6850 QC Intrmdt Std-QC 10ug/mL	CLO4 QC INT 10.ug/mL	0.1 mL	05/09/2019

STANDARD REPORT

Constituent

Working Standard - CLO4 QC INT

CLO4 QC INT — **Description** - 6850 QC Intrmdt Std-QC 10ug/mL

Standard: **41830**
MFG: ALS/SLC
MFG Lot: TNB: 05/09/2018
Pipette ID: Not Provided

Created By: Thomas Bosch
Create Date: 05/09/2018 10:05AM

Amount: 10 mL
Expires: 05/09/2019
Usable: Yes
Lab Lot: CLO4 QC INT 10.ug/mL

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	10 ug/mL

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
109	ASTM H2O	ASTM Type II Water	LAB 109	9.9 mL	11/07/2025
36748	CLO4 QCSTOCK	6850 QC Stock STD 1,000ug/mL	CLO4 QC STOCK	0.1 mL	03/31/2020

STANDARD REPORT

Constituent

Solvent Standard - ASTM H2O

ASTM H2O — Description - ASTM Type II Water

Standard: 109
MFG: DCL In House
MFG Lot: Not Provided
Part ID: Not Provided

Created By: ALS Support (Lims)
Create Date: 10/06/2005 09:10AM

Amount: 1000 L
Expires: 11/07/2025
Usable: Yes
Lab Lot: LAB 109

Pos.	Analyte	Name	Concentration
Solvent - Analyte(s) not applicable			

STANDARD REPORT

Constituent

Stock Standard - CLO4 QCSTOCK

CLO4 QCSTOCK — **Description:** 6850 QC Stock STD 1,000ug/mL

Standard: 36748
MFG: Ultra Scientific
MFG Lot: CP-0860
Part ID: ICC-013

Created By: Thomas Bosch
Create Date: 05/11/2017 01:05PM

Amount: 100 mL
Expires: 03/31/2020
Usable: Yes
Lab Lot: CLO4 QC STOCK

Pos.	Analyte	Name	Concentration
1	14797-73-0	Perchlorate	1000 ug/mL

STANDARD REPORT

Working Standard - CLO4ISTDWRK

CLO4ISTDWRK		**Description - Perchlorate ISTD Wrk 1,000ug/L**
Standard: 43730	**Created By:** Thomas Bosch	**Amount:** 25 mL
MFG: ALS/SLC	**Create Date:** 09/20/2018 09:09AM	**Expires:** 09/20/2019
MFG Lot: TNB: 05/09/2018	**Verified By:** Thomas Bosch	**Usable:** Yes
Pipette ID: Not Provided	**Verify Date:**	**Lab Lot:** CLO4ISTDWRK

Pos.	Analyte	Name	Concentration
1	14797-73-0-8385	Perchlorate 83:85 Ratio	1000 ug/L
2	14797-73-0-89	Perchlorate 89	1000 ug/L

Composition

Standard	Standard ID	Description	Lab Lot ID	Volume	Expires
43729	CLO4ISTDSTK	Perchlorate ISTD Stock	CLO4ISTDSTK	0.25 mL	04/28/2026

STANDARD REPORT

Constituent

Stock Standard - CLO4ISTDSTK

CLO4ISTDSTK		Description - Perchlorate ISTD Stock
Standard: 43729	**Created By:** Thomas Bosch	**Amount:** 1 mL
MFG: Cambridge Isotope	**Create Date:** 09/20/2018 09:09AM	**Expires:** 04/28/2026
MFG Lot: SDFF-012A	**Verified By:** Thomas Bosch	**Usable:** Yes
Part ID: OLM-7310-S	**Verify Date:**	**Lab Lot:** CLO4ISTDSTK

Pos.	Analyte	Name	Concentration
1	14797-73-0-8385	Perchlorate 83:85 Ratio	100 ug/mL
2	14797-73-0-89	Perchlorate 89	100 ug/mL

ULTRA SCIENTIFIC
Analytical Solutions

Certificate of Analysis

ISO Guide 34 Reference Material

Product Number: ICC-013
Lot Number: CP-0860

Lot Issue Date: 29-Feb 2016
Expiration Date: 31-Mar 2020

Product Name: Perchlorate IC Standard

Description:
This Reference Material (RM) was gravimetrically prepared in accordance with ISO Guide 34 and under ULTRA Scientific's ISO 9001 registered quality system. The neat materials used for this product have been verified by ULTRA's ISO 17025 laboratory and under ULTRA's ISO Guide 34 accreditation. The analyte concentrations were verified by ULTRA's ISO 17025 accredited laboratory. For each analyte, the true value, with its uncertainty value calculated at the 95% confidence level, is reported below.

Analyte	Starting Material	Lot Number	Purity (%)	Calculated Value	True Value	Traceability & Method
perchlorate	potassium perchlorate	RM07987	100	1001 ± 5 µg/mL	976 ± 6 µg/mL	NIST SRM 3141A; ICP-OES

Solvent: water (low TOC, < 50 ppb)

Storage: Store at Room Temperature (15° to 30°C).

Traceability:
Traceability has been established through an unbroken chain of comparisons, each having stated uncertainties. Comparisons are based on appropriate physical or chemical measurements, including gravimetric or volumetric dilution, where the mass or volume of a solution before and after dilution is measured. The balances used for these measurements are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1, ISO 9001, ISO 17025, and ISO Guide 34. Calibrated Class A glassware is used for volumetric measurements. Thermometers are calibrated against a NIST traceable thermometer in accordance with NIST Special Publication 819.

Estimation of Uncertainties:
The true value is reported, with its uncertainty value calculated at the 95% confidence level.

Homogeneity:
This RM was formulated and unitized according to an in-house procedure and is guaranteed to be homogeneous. There is no minimum sub-sample size required.

Intended Use:
This RM is intended for the preparation of working reference samples for use in routine laboratory analyses, calibration of instruments, validation of analytical methods, assessments of measurement methods and continuing calibration verification.

Instructions for Use:
Sample aliquots for analysis should be withdrawn at 20°C to 25°C immediately after opening and should be processed without delay for the true value to be valid within the stated uncertainties. Do not pipet from the bottle. Do not return any material removed for pipetting to the bottle. Tightly cap the bottle after removing any material and store according to the instructions noted above.

Hazards:
Refer to the Safety Data Sheet for information regarding this RM.

Expiration of Certification:
The certification of this RM is valid, within the measurement uncertainty specified, until the expiration date specified above, provided the RM is handled and stored in accordance with the instructions given in this certificate. This certification is nullified if the RM is damaged, contaminated, or otherwise modified.

ULTRA SCIENTIFIC
Analytical Solutions

Certificate of Analysis

ISO Guide 34 Reference Material

Product Number: ICC-013
Lot Number: CP-0860

Lot Issue Date: 29-Feb 2016
Expiration Date: 31-Mar 2020

Maintenance of Certification:
The real-time, long term stability of the RM may be monitored over the lifetime of the certification. If substantive changes occur that affect the certification before the expiration of this certificate, ULTRA Scientific will notify the purchaser.

Peter A. King, Ph.D.
VP, Technical Operations

Daniel J. Lamendola
Director of QA/RA

125 Market Street
New Haven, CT 06513
USA

AccuStandard®

Tel (203)786-5290
Fax (203)786-5287
www.AccuStandard.com

CERTIFICATE OF ANALYSIS

S 43659

AccuTrace™ Reference Standard

Catalog No: IC-PER-10X-1
Description: Perchlorate Standard
Element: Perchlorate (ClO_4)
SRM: Ind. Std.
Lot: 218065075
Matrix: Water
Hazards: *Refer to SDS for complete safety information*

GHS

Signal Word: None

Date Certified: Jun 25, 2018
Expiration: Jul 25, 2020
Sample Size: 100 mL
Components: 1
Storage Condition: Ambient (>5 °C)

Included on ISO/IEC 17025 Scope of Accreditation: Yes

Included on ISO 17034 Scope of Accreditation: Yes

Component		SRM #	Prepared Concentration (µg/mL)
ClO_4	Perchlorate	Ind. Std.	1000

The gravimetric uncertainty for this product is ±0.24%.
The final solution was checked against an independent standard to verify its concentration.
We use the highest purity raw materials available to minimize impurity levels in the final solution. Typically 99.999%+ pure starting materials are used as well as ASTM Type I 18 megohm deionized water.
All solutions are filtered through a 0.2 µm filter prior to being bottled.
All glassware used in preparation is Class A and calibrated regularly.
All weights are traceable through NIST, Test No. 822-275872-11
All bottles are triple rinsed with deionized water prior to use.
Shake bottle prior to use and do not pipette directly out of the bottle. Use only cleaned Class A volumetric glassware.
We certify the accuracy of this standard to be ±0.5% of the stated value until its expiration date provided it is kept tightly capped and stored under the conditions stated above.

Certified By: Meigan O'Leary
Meigan O'Leary, Inorganic QC Manager

For use in routine laboratory analysis.

AccuStandard is accredited to ISO 17034, ISO/IEC 17025 and certified to ISO 9001:2015

QR-ORG/INO-001
Rev. 5/18

Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:
ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP

23118

Product Name: (Isotopic Label & Enrichment Specification)	PERCHLORIC ACID, SODIUM SALT (18O4, 90%+) 100 UG/ML IN WATER
Lot Number:	SDDG-013
Catalog Number:	OLM-7310-S

Product Information

Chemical Purity Specification:	≥98%
Labeled CAS Number:	NA
Unlabeled CAS Number:	7601-89-0
MW*:	130.4
Chemical Formula:	NaCl*O4
Storage:	Store at room temperature away from light and moisture.
Stability:	See storage and expiration date.

Certification

Cambridge Isotope Laboratories, Inc. guarantees that this material meets or exceeds the specifications stated. Absolute identity as well as chemical and isotopic purities are assured by the use of unambiguous synthetic routes and multiple chemical analyses whenever possible. Results are representative of QC testing at time of release from Quality Control unless otherwise stated.

Volumetric measurements were made with Class A glassware. Gravimetry is traceable to the NIST through calibrated balances and certified, calibrated, standard weights. The calibrations are traceable to the NIST under Test No. 822/270236-04. The calibrations also meet specifications outlined in ISO 9001, ISO/IEC 17025, ANSI/NSCL Z540-1-1994, NCR Document 10CFR50 Appendix B, and applicable subdocuments.

This COA references the bulk catalog number before packaging. The COA also applies to the CIL finished good catalog number. Some possible packaging sizes and their corresponding suffix are -1.2, -1, -0.5, -10, or -0.1.

* *For isotopically labeled compounds, MW listed is for the fully enriched product.*

Approved by: T. J. Eckersley

Timothy J. Eckersley, Ph.D., Quality Assurance

Quality Control Tests and Results

QC Release Date	2/27/2014
Expiration Date	2/27/2024
Concentration Based on Gravimetry	102 µg/mL
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 ± 2.8 µg/mL (k=2)

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data

atch Report: C:\HPCHEM\1\DATA\25NOV18D\25NOV18S.B

Batch Review Method:
C:\HPCHEM\1\METHODS\CLO4-DPR.M

['#' ==> Run has not been reprocessed with Batch Review Method
'*' ==> Run has been saved with batch file]

#	Sample	Location	Inj	SampleType	Run	Perchlorate Area	Perchlorate RT	Perchlorate Amount
*	628724 C	Vial 71	1	Control	1	1.50656e6	7.901	25.13447
#*	628725 L	Vial 72	1	Control	2	5.73694e4	7.903	1.00208
#*	628726 I	Vial 73	1	Control	3	4.46329e4	7.903	8.57411e-1
#*	628727 L	Vial 74	1	Control	4	0.00000	0.000	0.00000
#*	628728 Q	Vial 75	1	Control	5	3.43759e5	7.884	4.69002
*	1831619001	Vial 76	1	Sample	6	0.00000	0.000	0.00000
*	1831619002	Vial 77	1	Sample	7	0.00000	0.000	0.00000
*	1831619003	Vial 78	1	Sample	8	0.00000	0.000	0.00000
*	1831619004	Vial 79	1	Sample	9	0.00000	0.000	0.00000
*	1831619005	Vial 80	1	Sample	10	0.00000	0.000	0.00000
*	1831619006	Vial 81	1	Sample	11	0.00000	0.000	0.00000
*	1831619007	Vial 82	1	Sample	12	1.14508e5	7.689	3.92309
*	1831619008	Vial 83	1	Sample	13	1.28042e5	7.691	3.94137
*	1831619009	Vial 84	1	Sample	14	1.01862e5	7.674	2.50823

#	Sample	Location	Inj	SampleType	Run	CLO4-85 Area	CLO4-85 RT	CLO4-85 Amount
*	628724 C	Vial 71	1	Control	1	4.49212e5	7.916	24.83590
#*	628725 L	Vial 72	1	Control	2	1.99757e4	7.925	1.02045
#*	628726 I	Vial 73	1	Control	3	1.64799e4	7.918	8.96262e-1
#*	628727 L	Vial 74	1	Control	4	0.00000	0.000	0.00000
#*	628728 Q	Vial 75	1	Control	5	1.13950e5	7.905	5.09359
*	1831619001	Vial 76	1	Sample	6	0.00000	0.000	0.00000
*	1831619002	Vial 77	1	Sample	7	0.00000	0.000	0.00000
*	1831619003	Vial 78	1	Sample	8	0.00000	0.000	0.00000
*	1831619004	Vial 79	1	Sample	9	0.00000	0.000	0.00000
*	1831619005	Vial 80	1	Sample	10	0.00000	0.000	0.00000
*	1831619006	Vial 81	1	Sample	11	0.00000	0.000	0.00000
*	1831619007	Vial 82	1	Sample	12	4.68930e4	7.703	5.20533
*	1831619008	Vial 83	1	Sample	13	5.39721e4	7.706	5.37917
*	1831619009	Vial 84	1	Sample	14	3.96425e4	7.687	3.10601

#	Sample	Location	Inj	SampleType	Run	CLO4-89-ISTD Area	CLO4-89-ISTD RT	CLO4-89-ISTD Amount
*	628724 C	Vial 71	1	Control	1	1.78859e5	7.929	5.00000
#*	628725 L	Vial 72	1	Control	2	2.23196e5	7.935	5.00000
#*	628726 I	Vial 73	1	Control	3	2.12410e5	7.937	5.00000
#*	628727 L	Vial 74	1	Control	4	2.19887e5	7.915	5.00000
#*	628728 Q	Vial 75	1	Control	5	2.35271e5	7.913	5.00000
*	1831619001	Vial 76	1	Sample	6	1.79512e5	7.783	5.00000
*	1831619002	Vial 77	1	Sample	7	1.24680e5	7.787	5.00000
*	1831619003	Vial 78	1	Sample	8	1.07092e5	7.795	5.00000
*	1831619004	Vial 79	1	Sample	9	1.65794e5	7.761	5.00000
*	1831619005	Vial 80	1	Sample	10	1.05122e5	7.718	5.00000
*	1831619006	Vial 81	1	Sample	11	9.93887e4	7.718	5.00000
*	1831619007	Vial 82	1	Sample	12	9.46797e4	7.724	5.00000
*	1831619008	Vial 83	1	Sample	13	1.05348e5	7.719	5.00000
*	1831619009	Vial 84	1	Sample	14	1.36385e5	7.708	5.00000

*** End of Report ***

atch Report: C:\HPCHEM\1\DATA\26NOV18D\26NOV18S.B

Batch Review Method:
C:\HPCHEM\1\METHODS\CLO4-DPR.M

['#' ==> Run has not been reprocessed with Batch Review Method
'*' ==> Run has been saved with batch file]

#	*	Sample	Location	Inj	SampleType	Run	Perchlorate Area	Perchlorate RT	Perchlorate Amount
	*	628729 C	Vial 71	1	Control	6	1.25932e6	7.671	21.91188
	*	628730 L	Vial 72	1	Control	7	4.75152e4	7.678	8.86851e-1

#	*	Sample	Location	Inj	SampleType	Run	CLO4-85 Area	CLO4-85 RT	CLO4-85 Amount
	*	628729 C	Vial 71	1	Control	6	4.16774e5	7.689	23.92430
	*	628730 L	Vial 72	1	Control	7	1.87160e4	7.694	9.89483e-1

#	*	Sample	Location	Inj	SampleType	Run	CLO4-89-ISTD Area	CLO4-89-ISTD RT	CLO4-89-ISTD Amount
	*	628729 C	Vial 71	1	Control	6	1.72663e5	7.703	5.00000
	*	628730 L	Vial 72	1	Control	7	2.16302e5	7.708	5.00000

*** End of Report ***

Sequence: C:\HPCHEM\1\SEQUENCE\CLO4\2018\NOV\25NOV18D.S

Sequence Table:

Method and Injection Info Part:

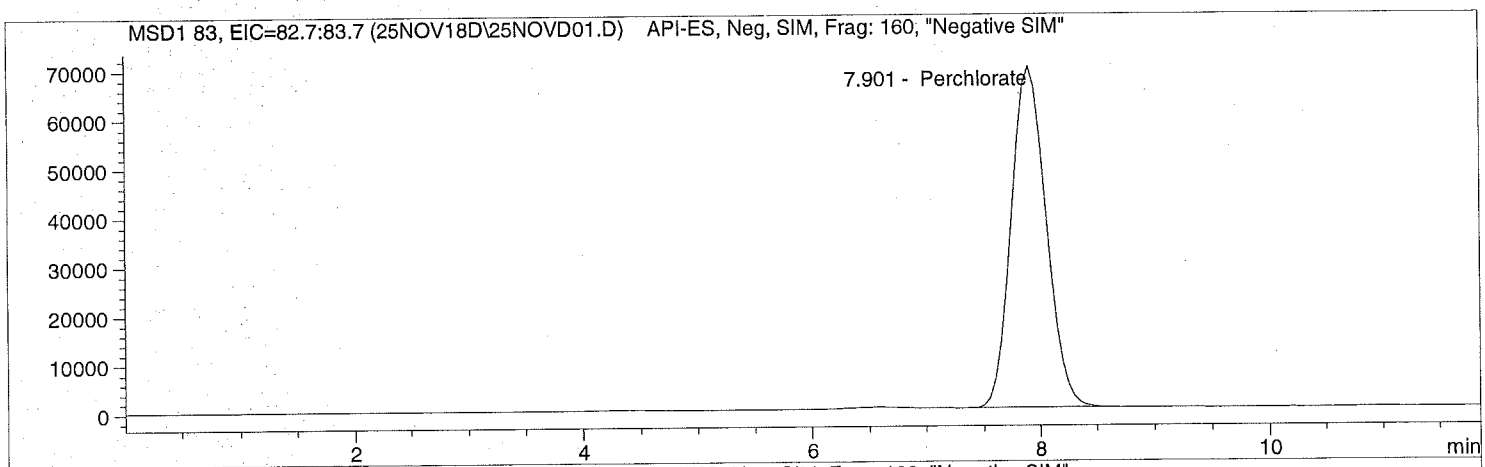
Line	Location	SampleName		Method	Inj	SampleType	InjVolume	DataFile
1	Vial 71	628724	CCV@25	CLO4-AQN	1	Ctrl Samp		
2	Vial 72	628725	LODV@1.	CLO4-AQN	1	Ctrl Samp		
3	Vial 73	628726	ICS@1.0	CLO4-AQN	1	Ctrl Samp		
4	Vial 74	628727	LMB	CLO4-AQN	1	Ctrl Samp		
5	Vial 75	628728	QC@5.0	CLO4-AQN	1	Ctrl Samp		
6	Vial 76	1831619001		CLO4-AQN	1	Sample		
7	Vial 77	1831619002		CLO4-AQN	1	Sample		
8	Vial 78	1831619003		CLO4-AQN	1	Sample		
9	Vial 79	1831619004		CLO4-AQN	1	Sample		
10	Vial 80	1831619005		CLO4-AQN	1	Sample		
11	Vial 81	1831619006		CLO4-AQN	1	Sample		
12	Vial 82	1831619007	MS	CLO4-AQN	1	Sample		
13	Vial 83	1831619008	MSD	CLO4-AQN	1	Sample		
14	Vial 84	1831619009		CLO4-AQN	1	Sample		
15	Vial 71	628729	CCV@25	CLO4-AQN	1	Ctrl Samp		
16	Vial 72	628730	LODV@1.	CLO4-AQN	1	Ctrl Samp		

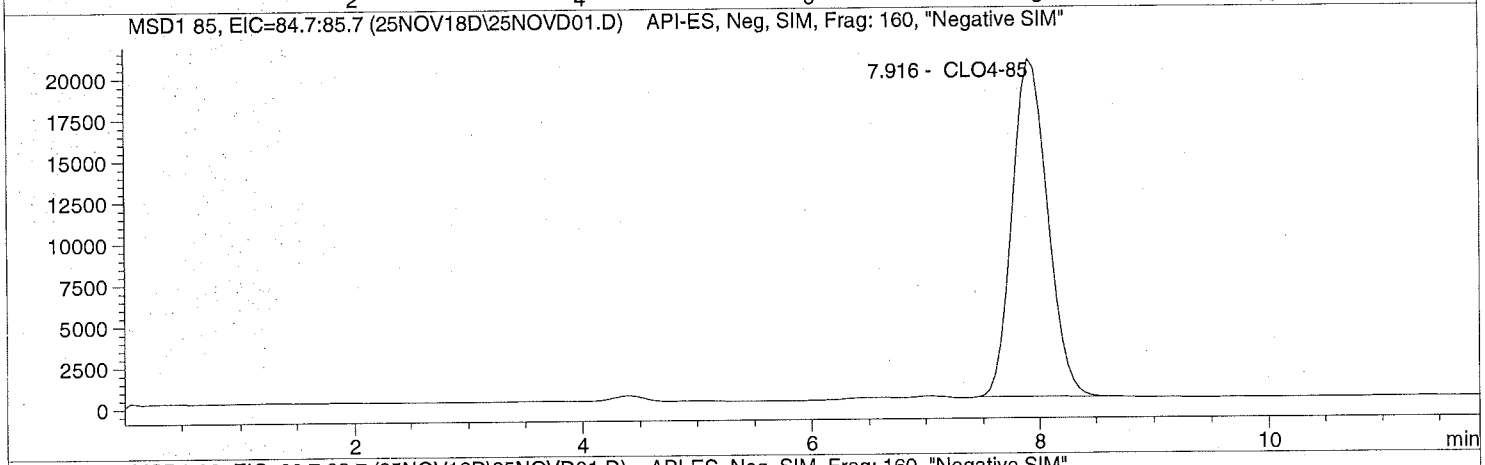
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD01.D Sample Name: 628724 CCV@25

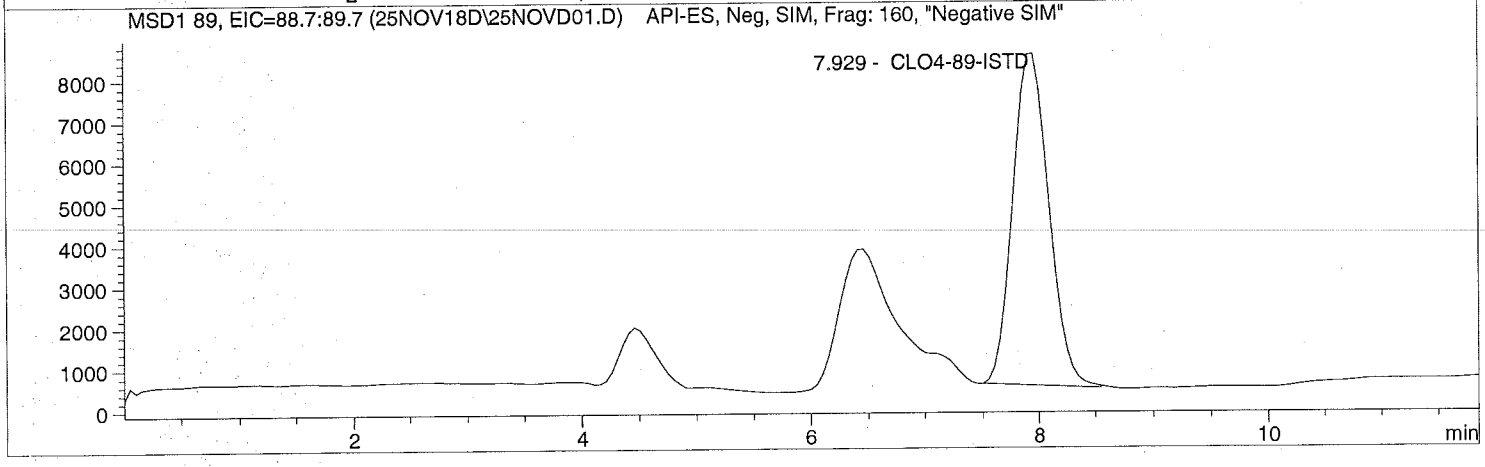
Injection Date:	11/25/2018 12:23:49	Seq Line:	1
Sample Name:	628724 CCV@25	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD01.D Sample Name: 628724 CCV@25

Injection Date:	11/25/2018 12:23:49	Seq Line:	1
Sample Name:	628724 CCV@25	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Wed, 21. Nov. 2018,01:02:02 pm
Multiplier: 1.000000
Dilution: 1.000000
Sample Amount: 25.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.901	PBA	1506563.5	25.1345	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.916	PBA	449212.3	24.8359	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.929	PBA	178859.0	5.0000	CLO4-89-ISTD

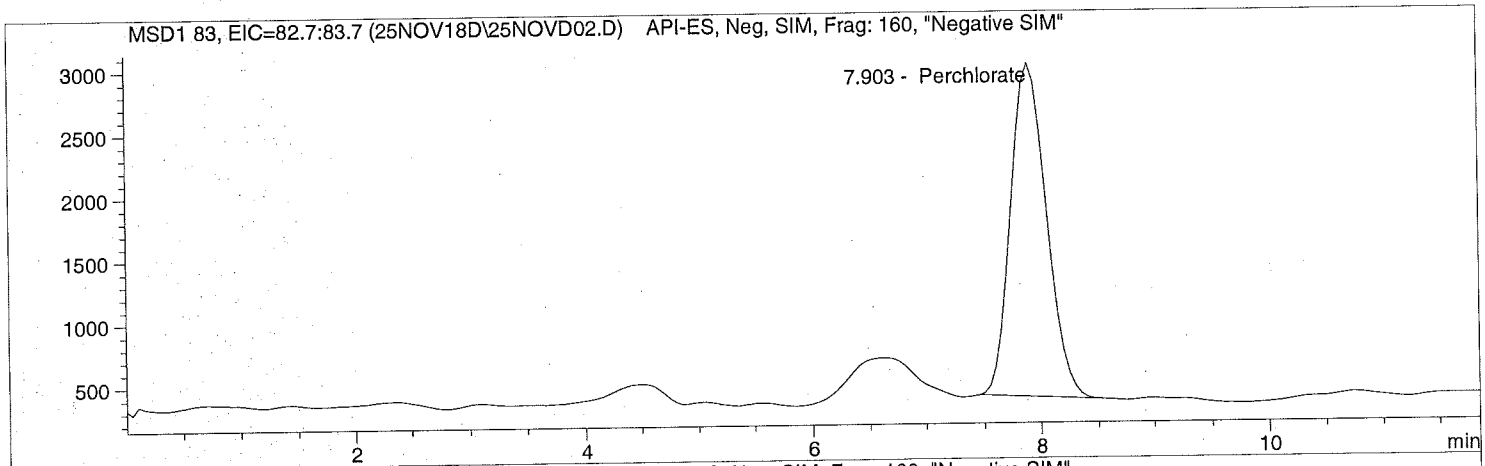
*** End of Report ***

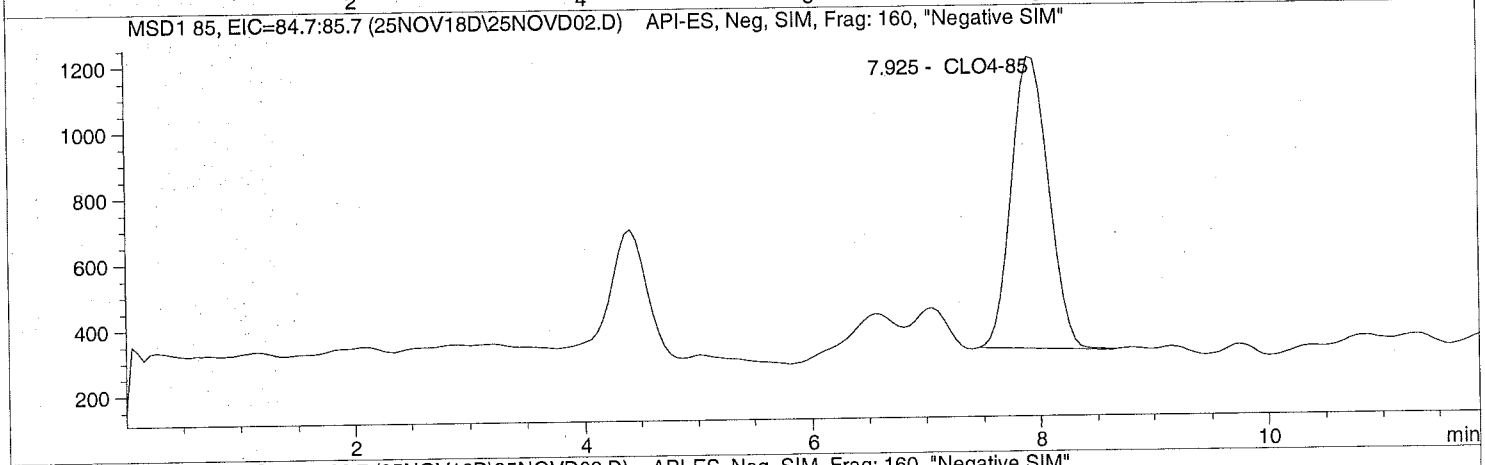
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD02.D Sample Name: 628725 LODV@1.

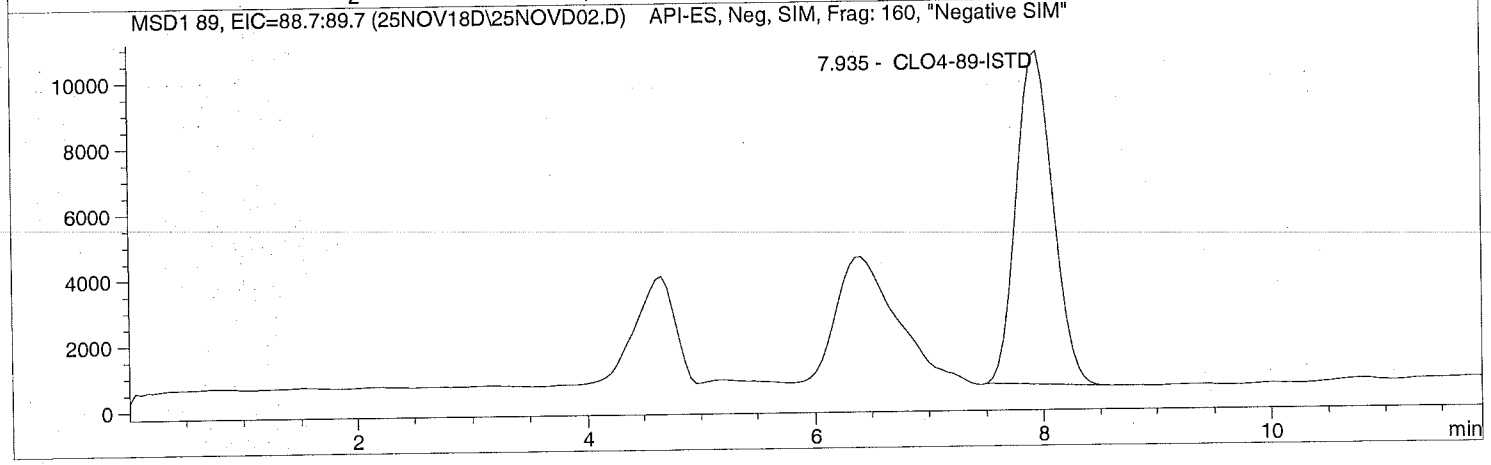
Injection Date:	11/25/2018 12:40:20	Seq Line:	2
Sample Name:	628725 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD02.D Sample Name: 628725 LODV@1.

Injection Date:	11/25/2018 12:40:20	Seq Line:	2
Sample Name:	628725 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.903	PBA	57369.4	1.0021	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.925	PBA	19975.7	1.0205	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.935	PBA	223196.3	5.0000	CLO4-89-ISTD

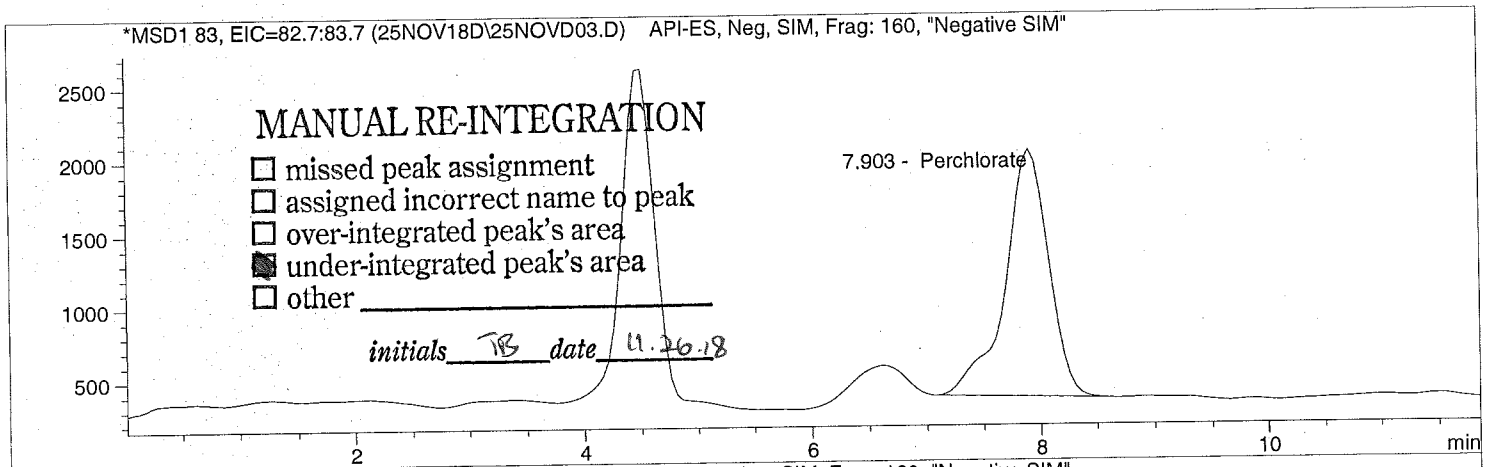
*** End of Report ***

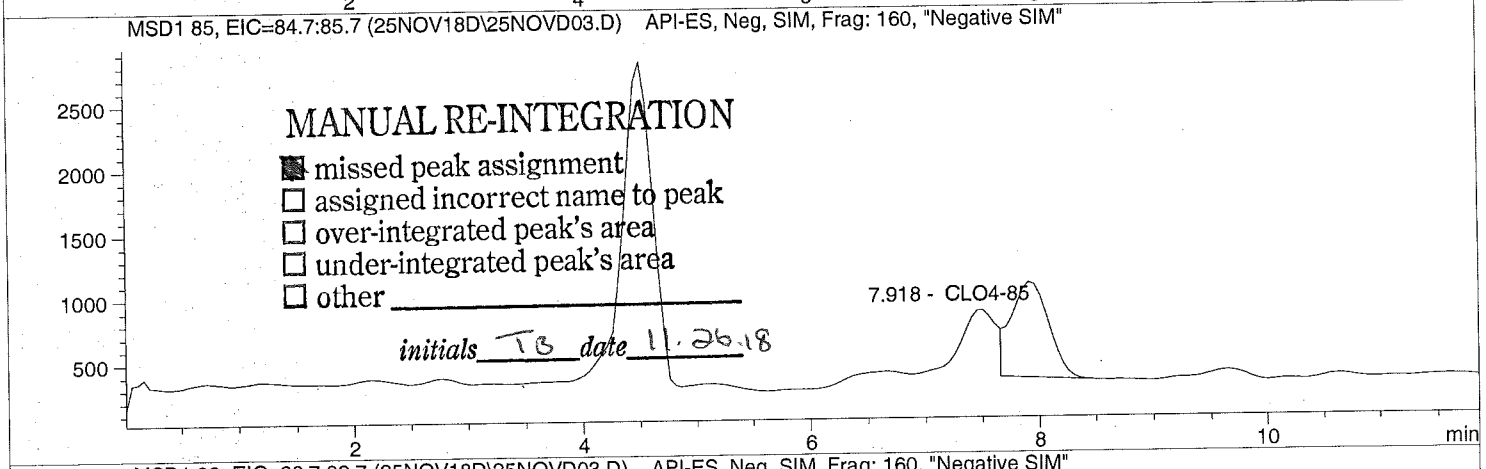
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD03.D Sample Name: 628726 ICS@1.0

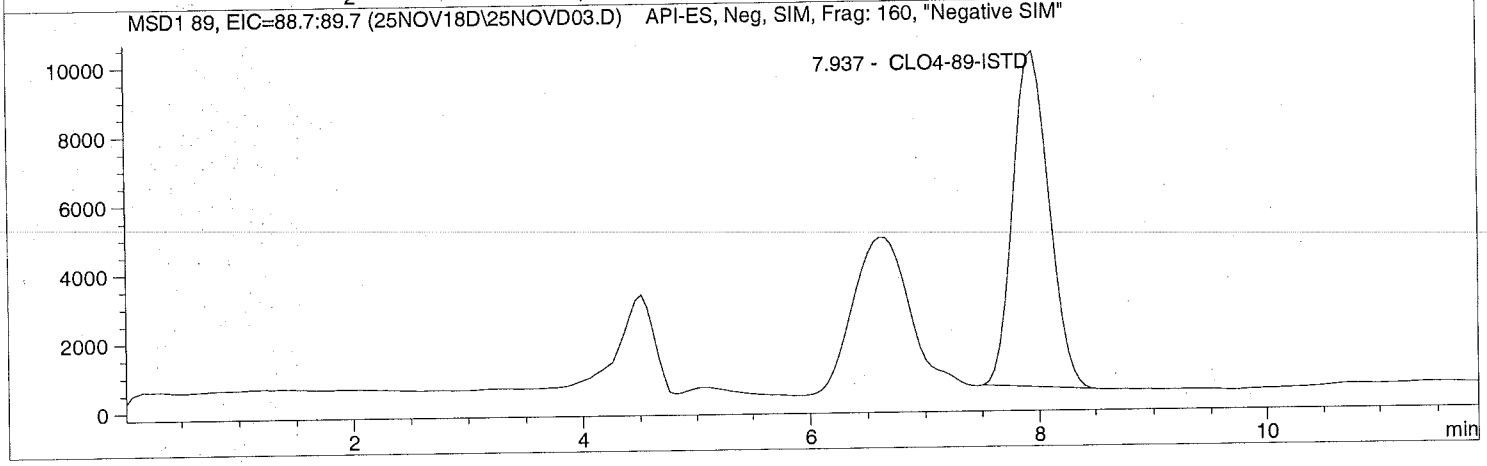
Injection Date:	11/25/2018 12:54:03	Seq Line:	3
Sample Name:	628726 ICS@1.0	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD03.D Sample Name: 628726 ICS@1.0

Injection Date:	11/25/2018 12:54:03	Seq Line:	3
Sample Name:	628726 ICS@1.0	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.903	MM	44632.9	0.8574	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.918	FM	16479.9	0.8963	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.937	PBA	212410.2	5.0000	CLO4-89-ISTD

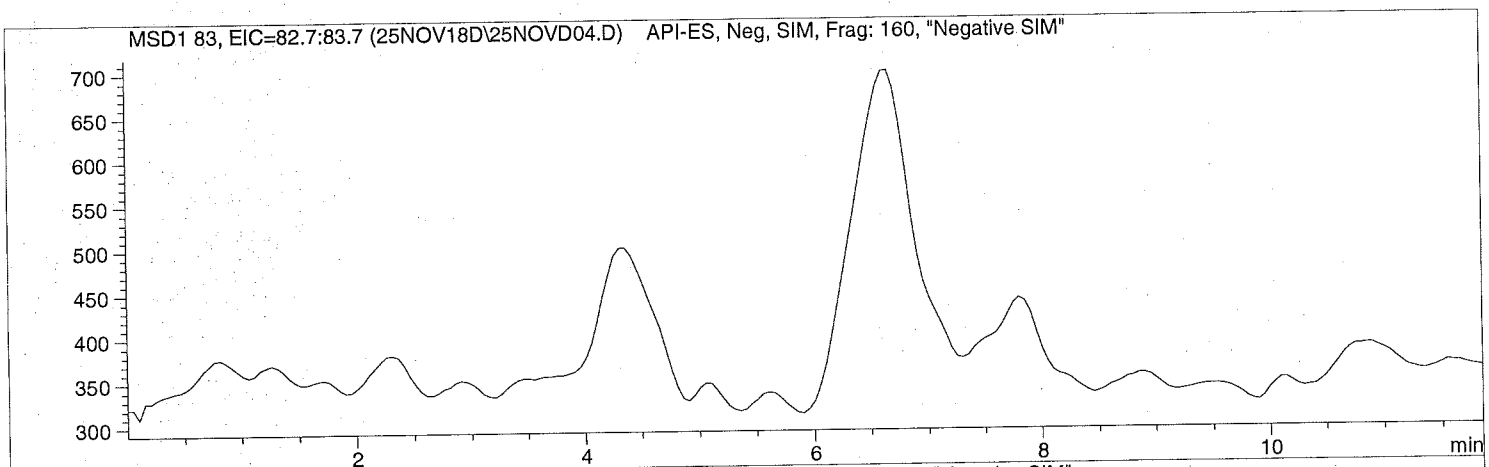
*** End of Report ***

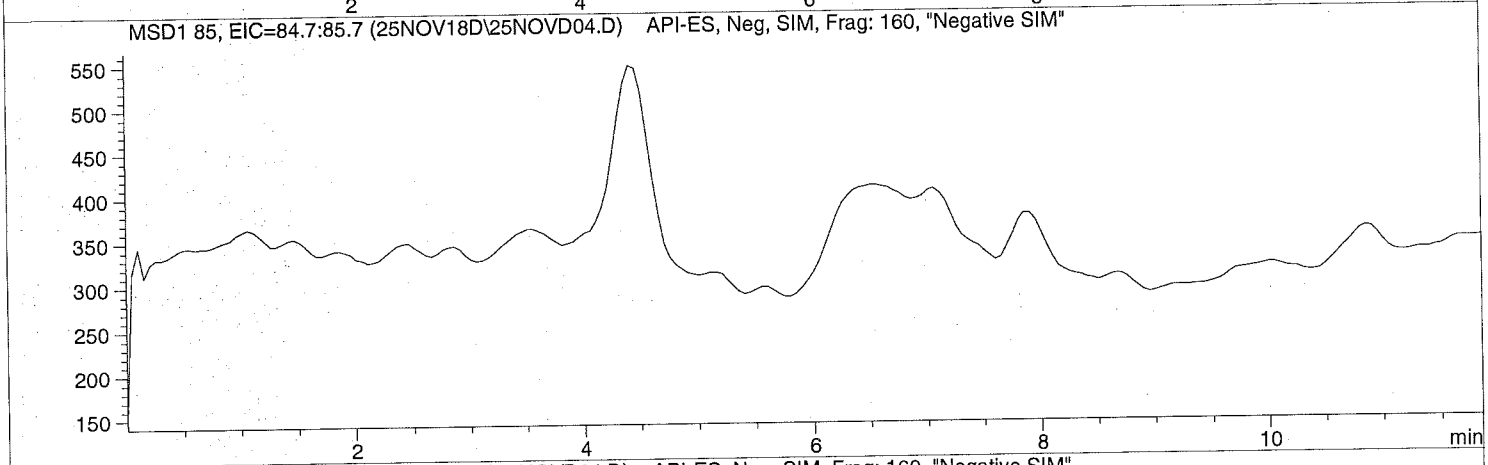
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD04.D Sample Name: 628727 LMB

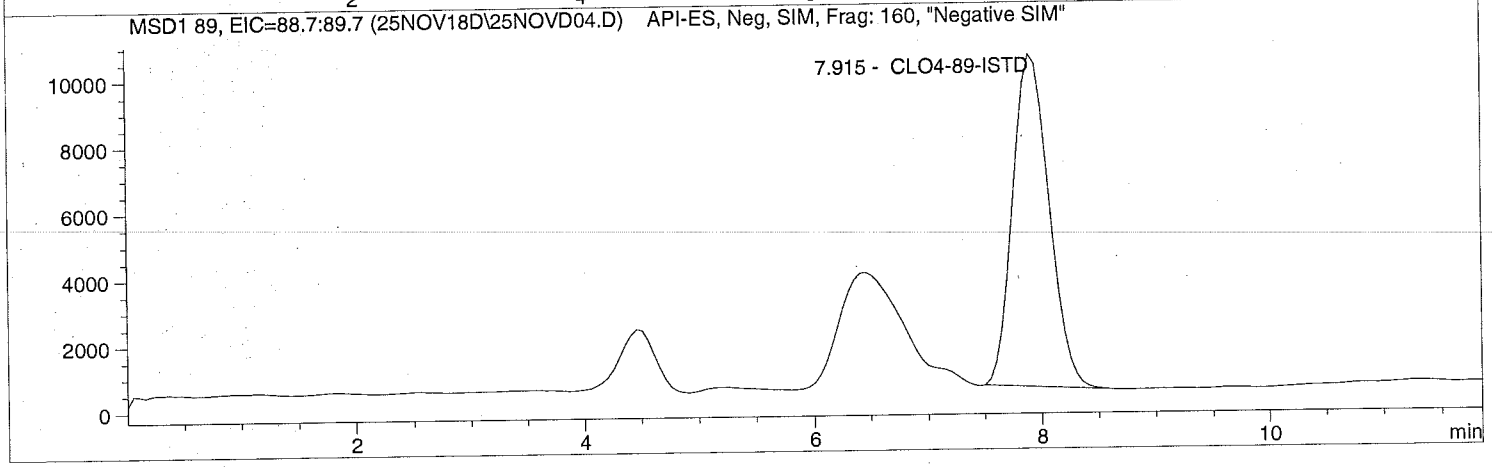
Injection Date:	11/25/2018 13:07:51	Seq Line:	4
Sample Name:	628727 LMB	Location:	Vial 74
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD04.D Sample Name: 628727 LMB

Injection Date:	11/25/2018 13:07:51	Seq Line:	4
Sample Name:	628727 LMB	Location:	Vial 74
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.915	PBA	219886.8	5.0000	CLO4-89-ISTD

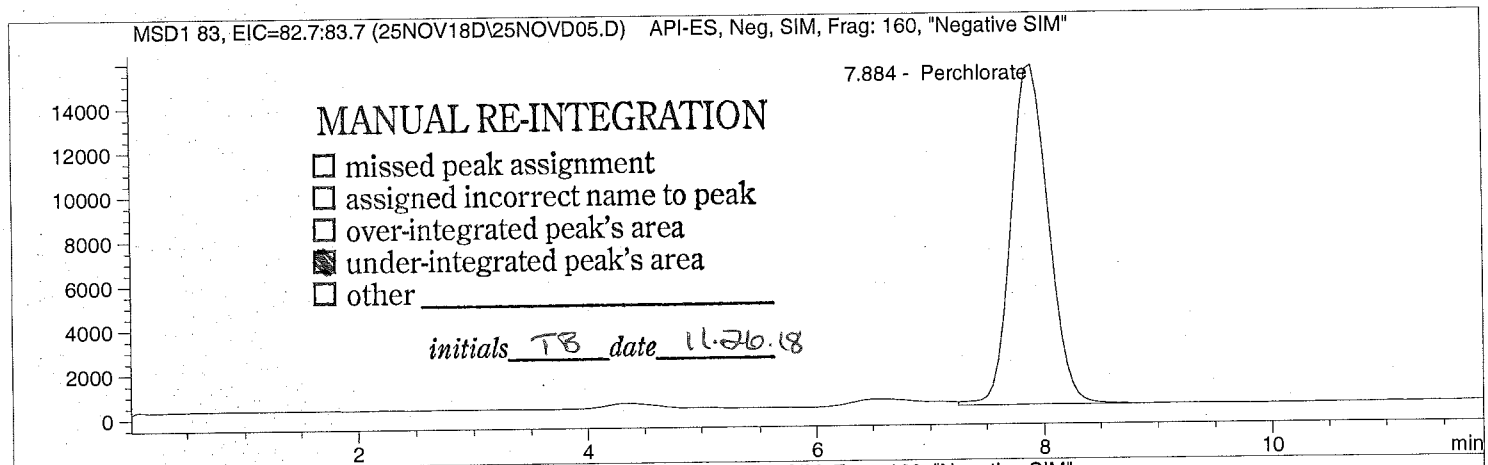
*** End of Report ***

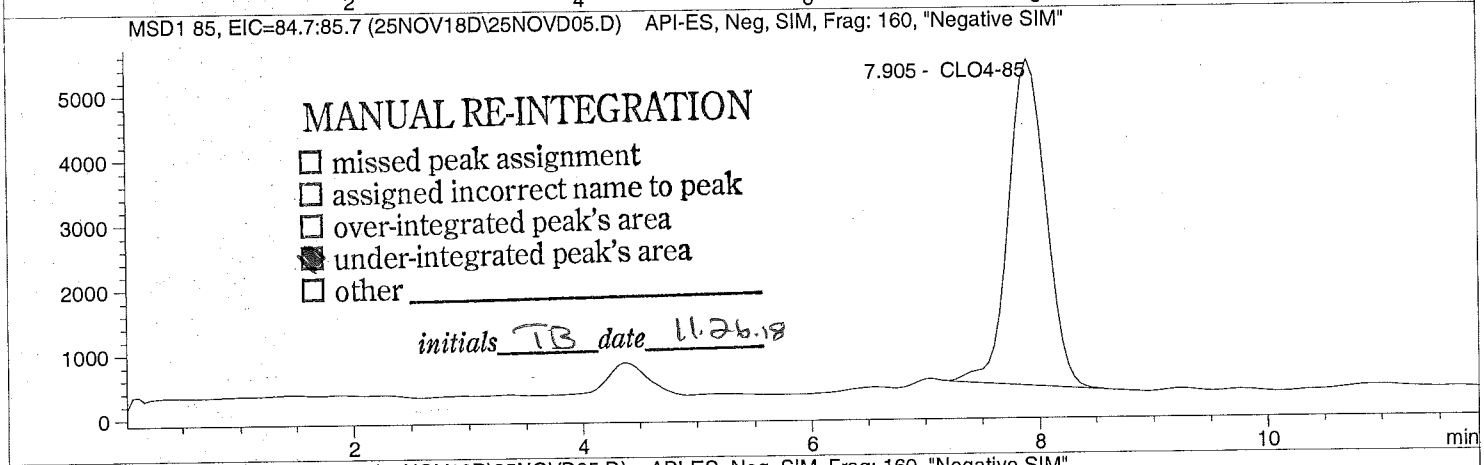
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD05.D Sample Name: 628728 QC@5.0

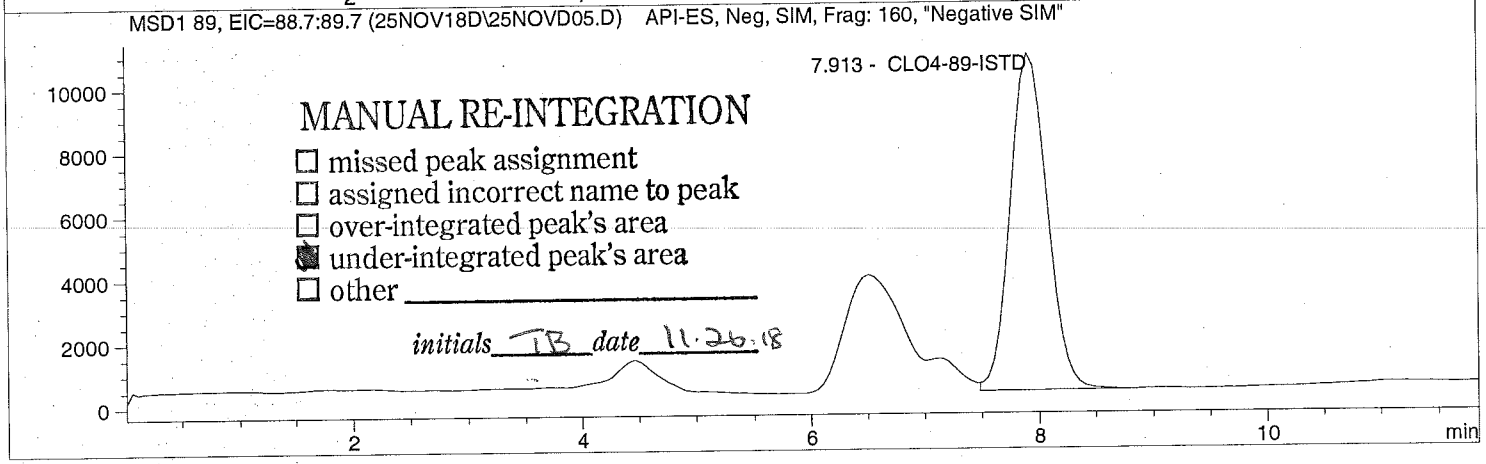
Injection Date:	11/25/2018 13:21:35	Seq Line:	5
Sample Name:	628728 QC@5.0	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD05.D Sample Name: 628728 QC@5.0

Injection Date:	11/25/2018 13:21:35	Seq Line:	5
Sample Name:	628728 QC@5.0	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	5.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.884	FM	343759.2	4.6900	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.905	MM	113950.0	5.0936	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.913	FM	235270.6	5.0000	CLO4-89-ISTD

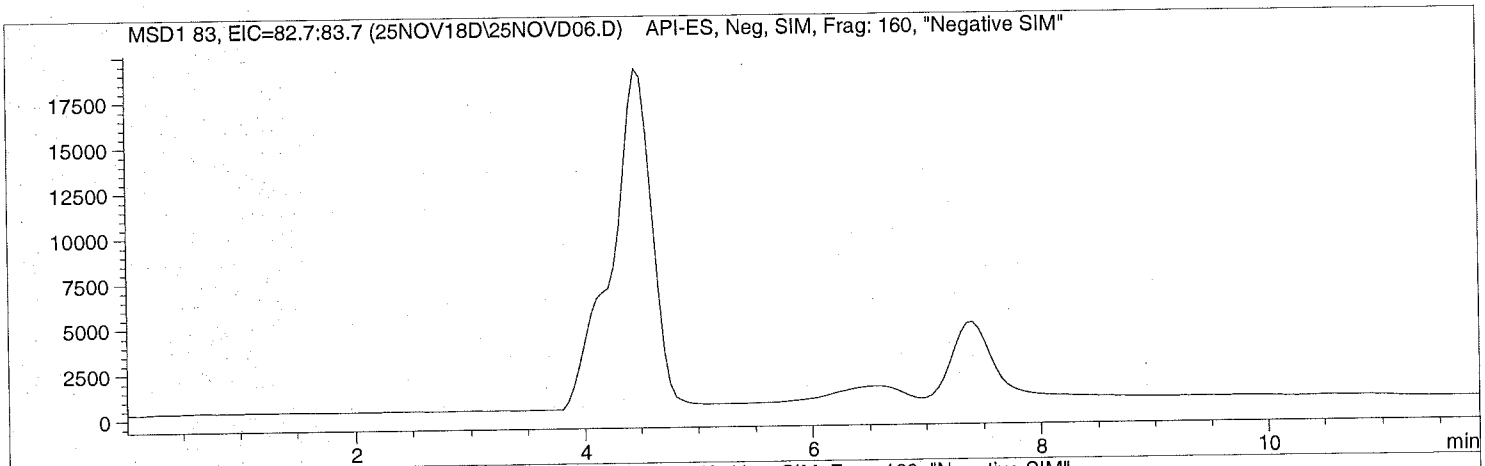
*** End of Report ***

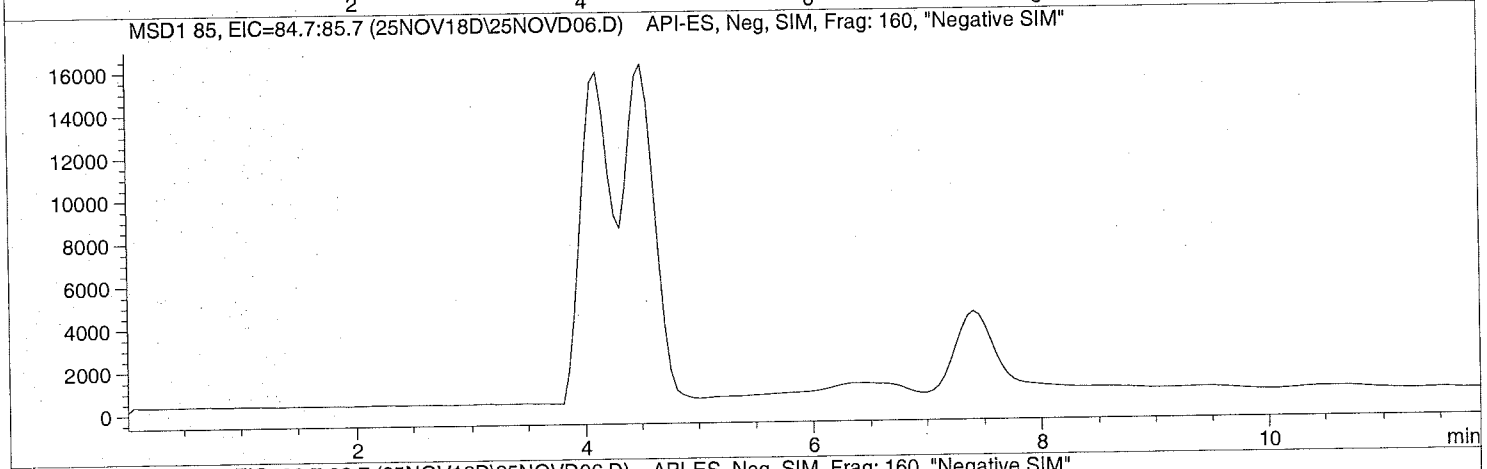
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD06.D Sample Name: 1831619001

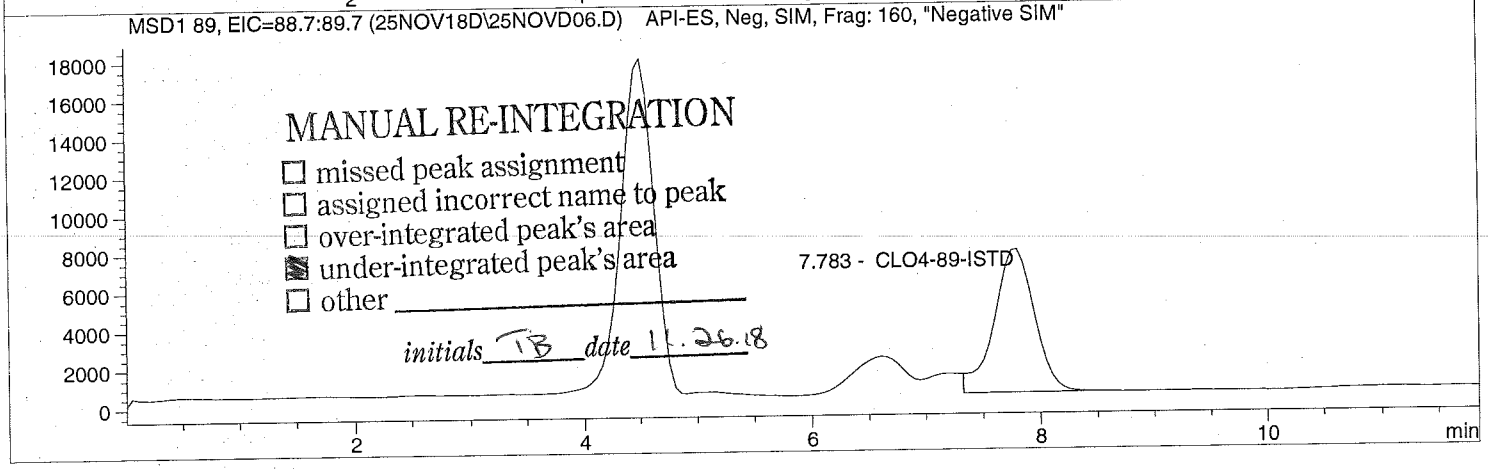
Injection Date:	11/25/2018 13:36:17	Seq Line:	6
Sample Name:	1831619001	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







MANUAL RE-INTEGRATION

- ☐ missed peak assignment
- ☐ assigned incorrect name to peak
- ☐ over-integrated peak's area
- ☒ under-integrated peak's area
- ☐ other _____

initials TB *date* 11.26.18

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD06.D Sample Name: 1831619001

Injection Date:	11/25/2018 13:36:17	Seq Line:	6
Sample Name:	1831619001	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Wed, 21. Nov. 2018,01:02:02 pm
Multiplier: 1.000000
Dilution: 1.000000
Sample Amount: 0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.783	FM	179512.1	5.0000	CLO4-89-ISTD

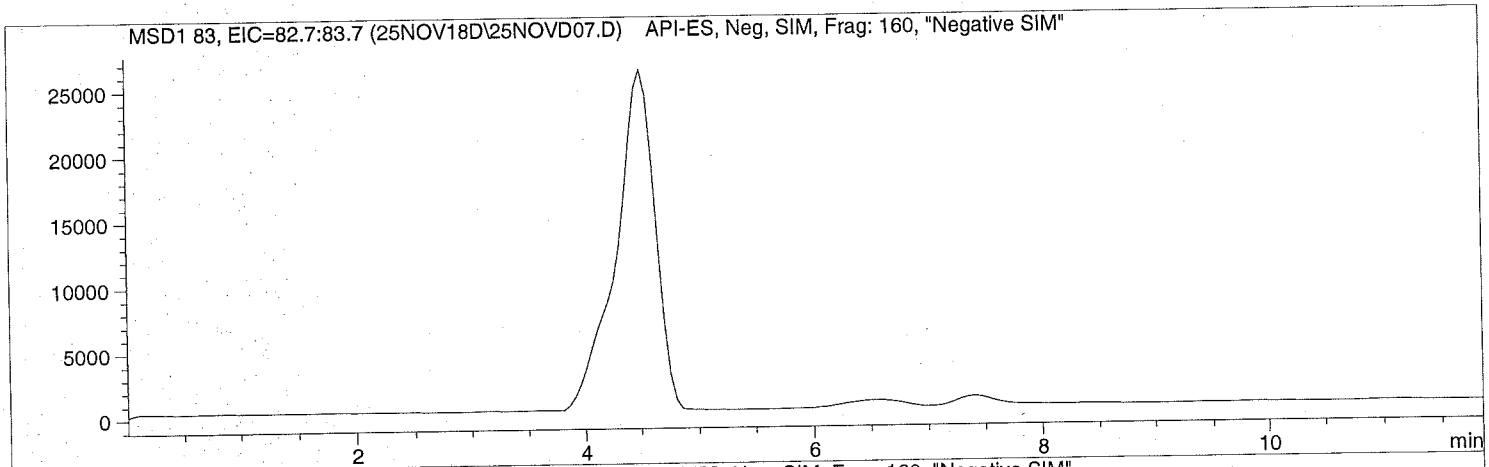
*** End of Report ***

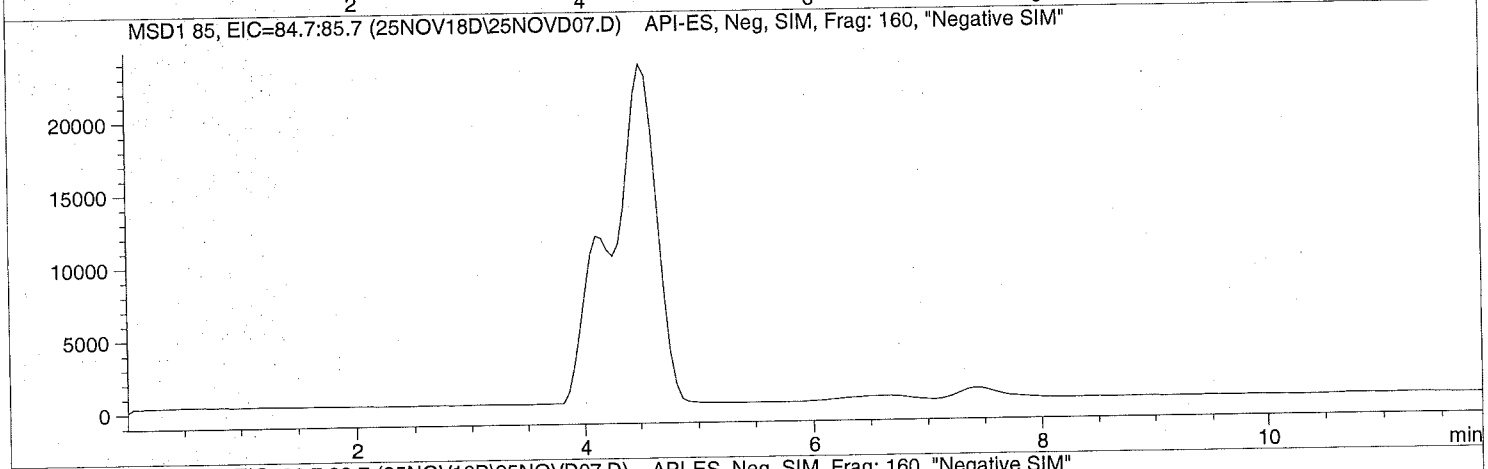
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD07.D Sample Name: 1831619002

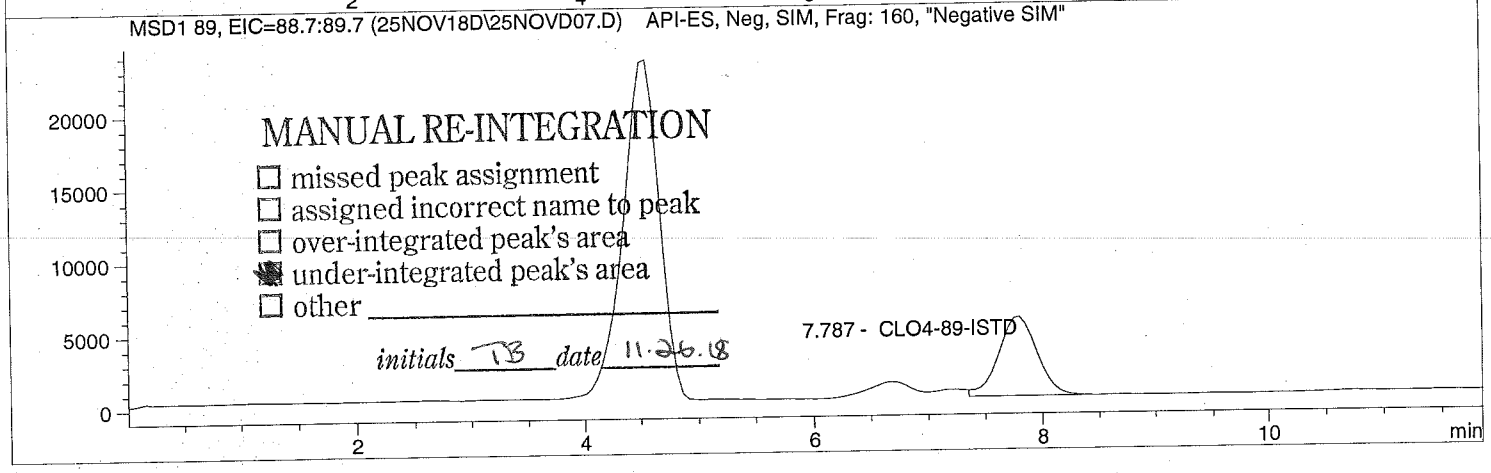
Injection Date:	11/25/2018 13:50:04	Seq Line:	7
Sample Name:	1831619002	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD07.D Sample Name: 1831619002

Injection Date:	11/25/2018 13:50:04	Seq Line:	7
Sample Name:	1831619002	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.787	FM	124680.2	5.0000	CLO4-89-ISTD

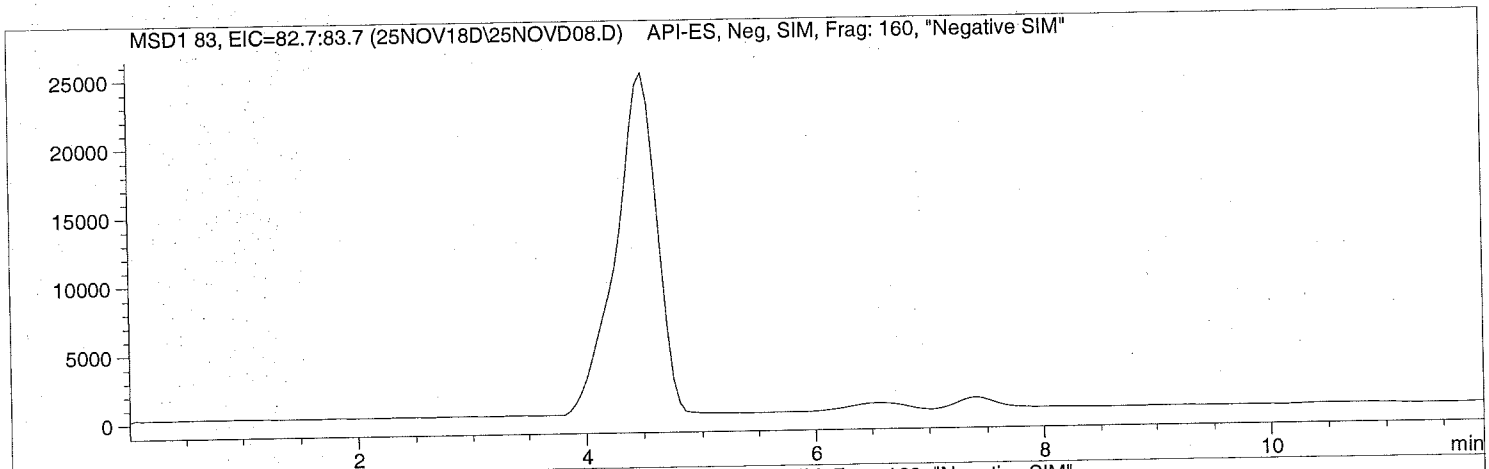
*** End of Report ***

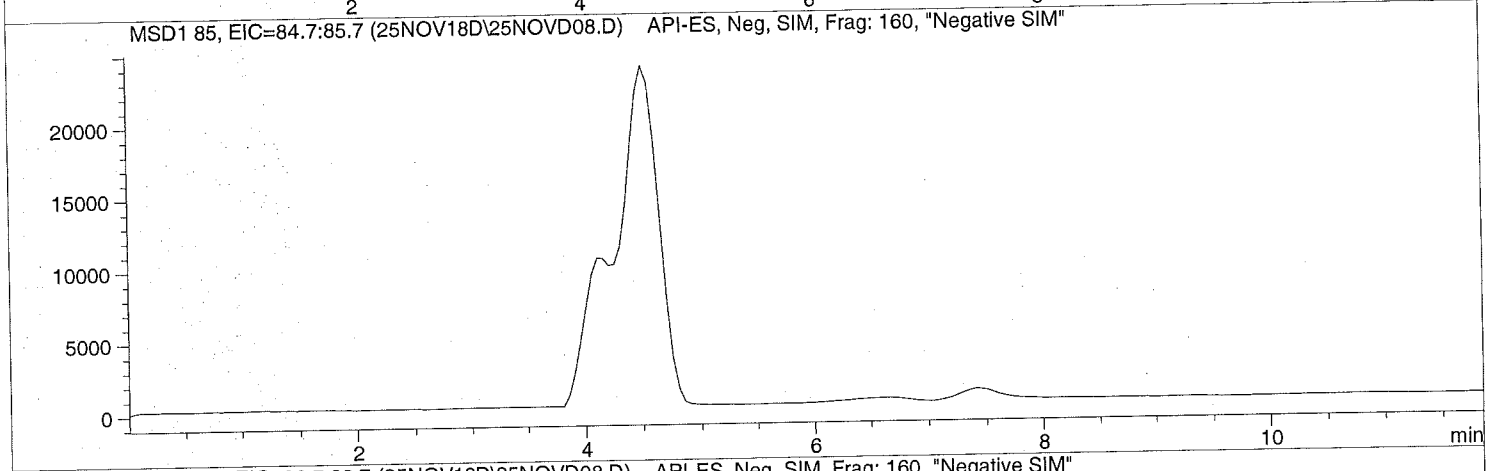
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD08.D Sample Name: 1831619003

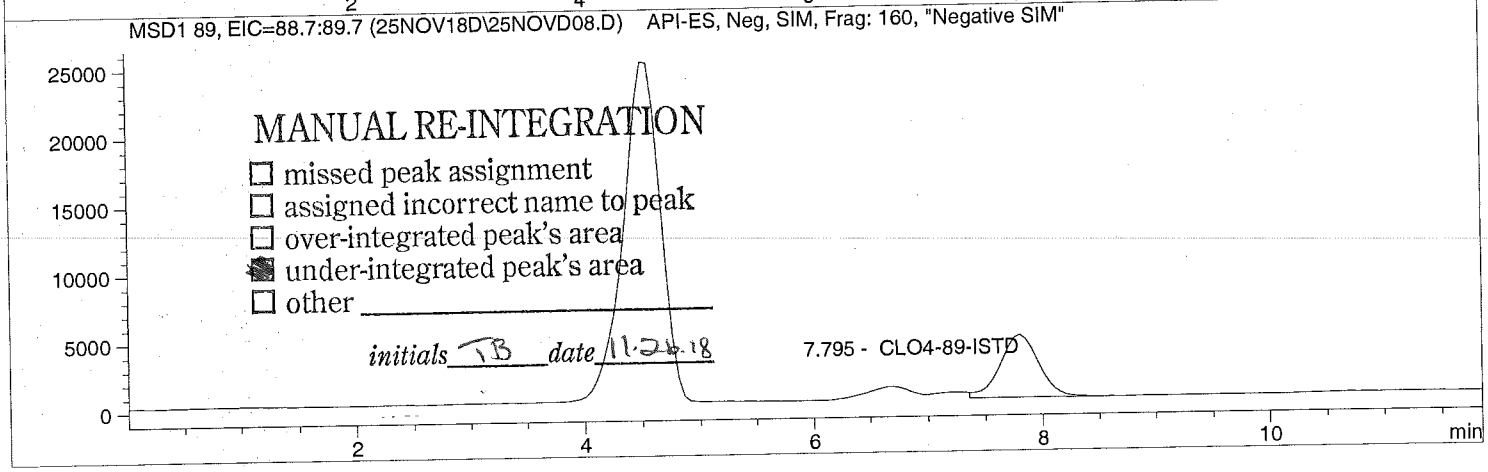
Injection Date:	11/25/2018 14:03:48	Seq Line:	8
Sample Name:	1831619003	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







MANUAL RE-INTEGRATION
☐ missed peak assignment
☐ assigned incorrect name to peak
☐ over-integrated peak's area
☒ under-integrated peak's area
☐ other _____
initials TB date 11.26.18

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD08.D Sample Name: 1831619003

Injection Date:	11/25/2018 14:03:48	Seq Line:	8
Sample Name:	1831619003	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.795	FM	107092.3	5.0000	CLO4-89-ISTD

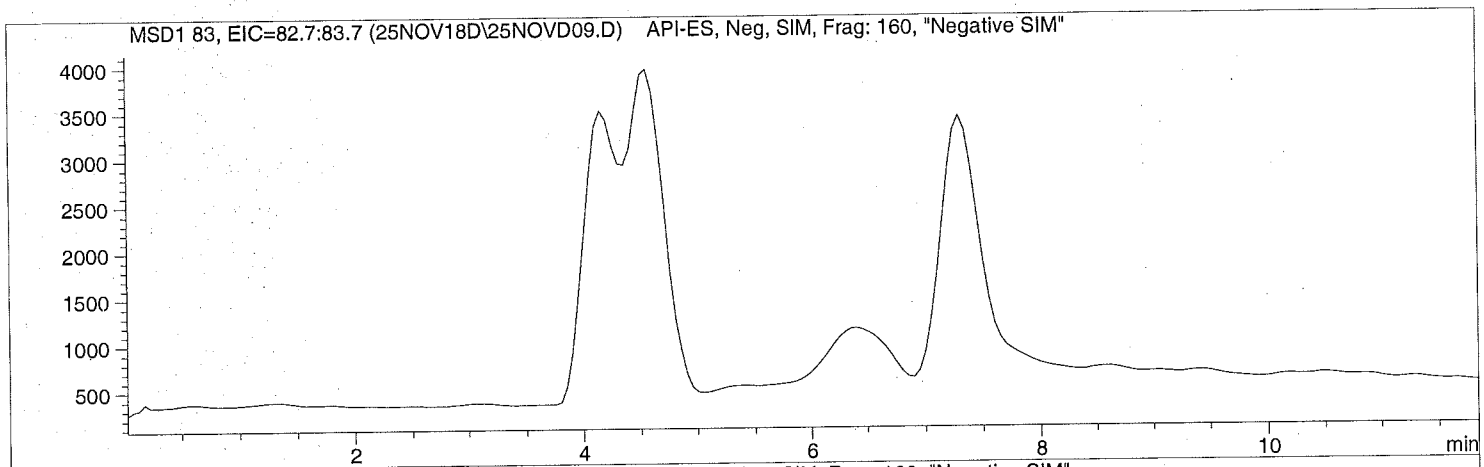
*** End of Report ***

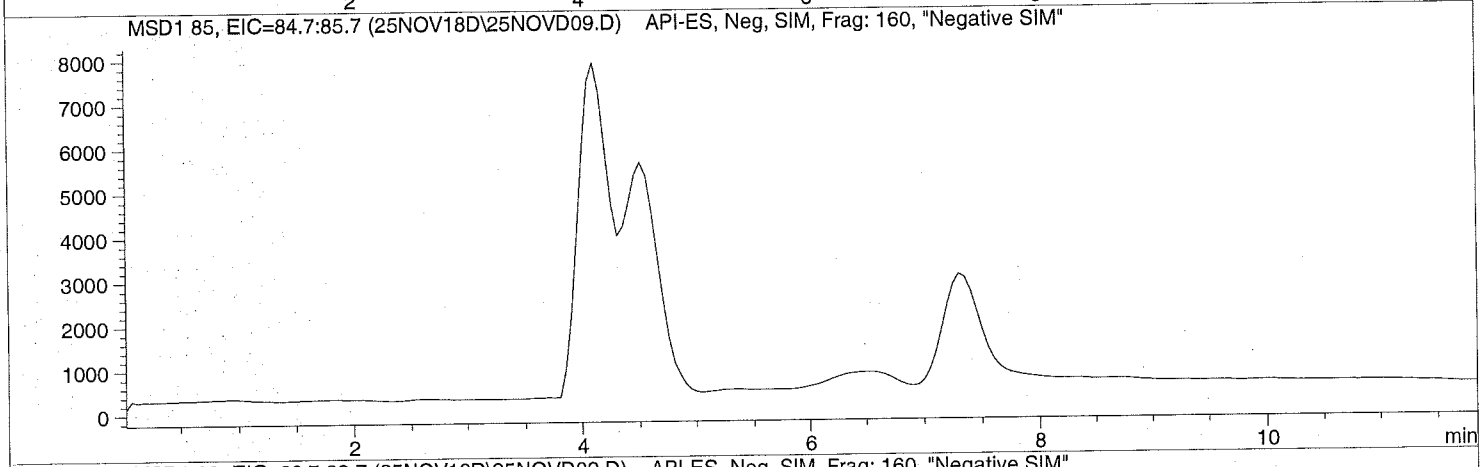
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD09.D Sample Name: 1831619004

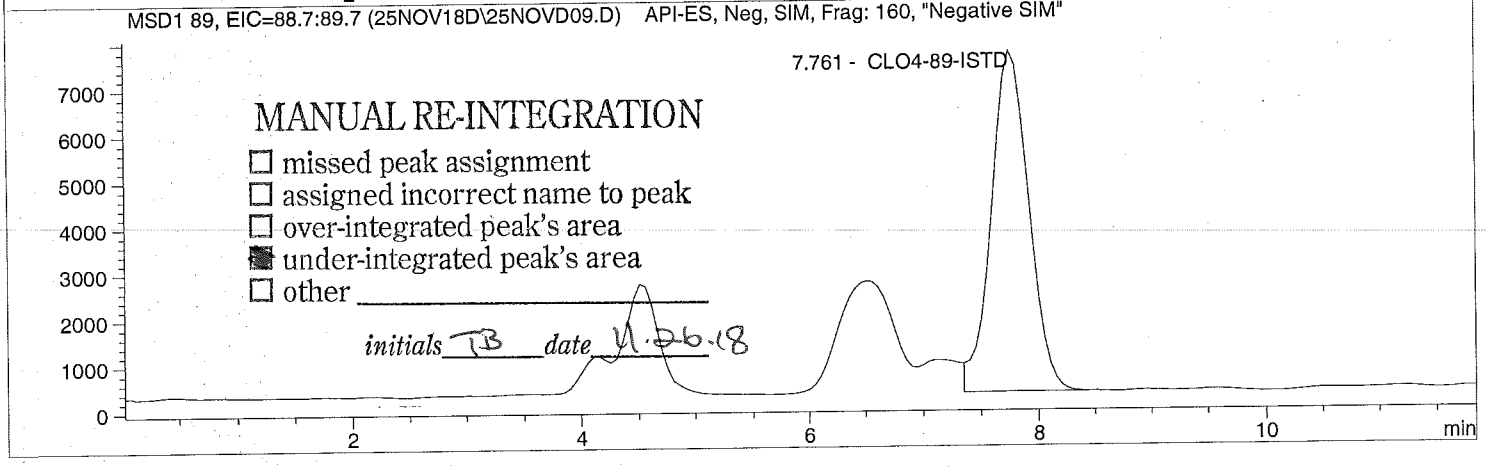
Injection Date:	11/25/2018 14:17:35	Seq Line:	9
Sample Name:	1831619004	Location:	Vial 79
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







MANUAL RE-INTEGRATION

- ☐ missed peak assignment
- ☐ assigned incorrect name to peak
- ☐ over-integrated peak's area
- ■ under-integrated peak's area
- ☐ other _____

initials TB *date* 11.26.18

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD09.D Sample Name: 1831619004

Injection Date:	11/25/2018 14:17:35	Seq Line:	9
Sample Name:	1831619004	Location:	Vial 79
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.761	FM	165794.3	5.0000	CLO4-89-ISTD

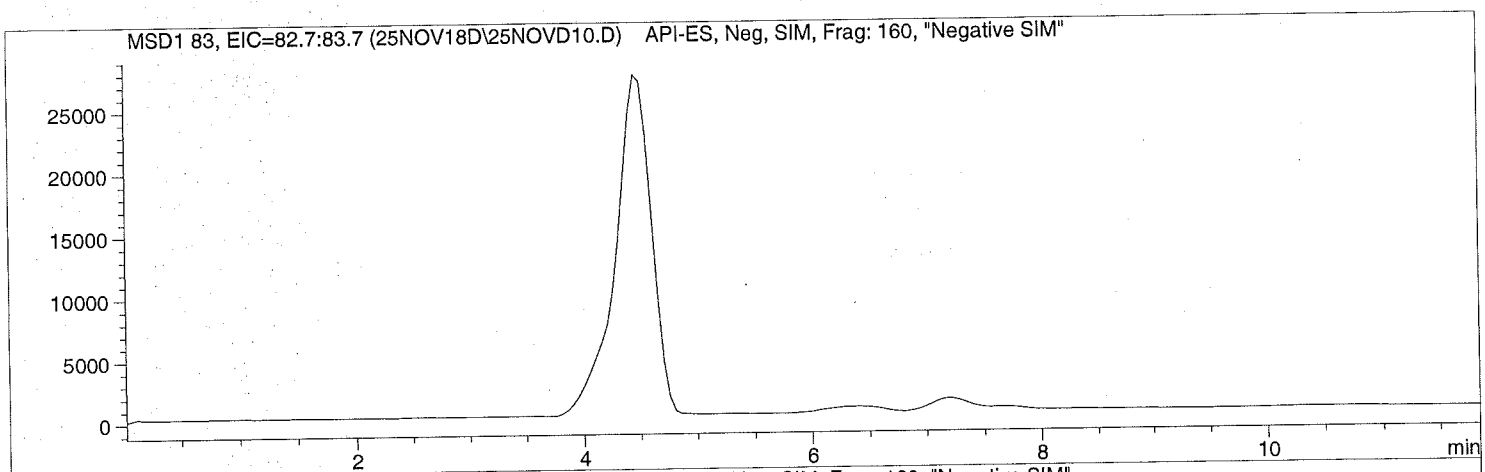
*** End of Report ***

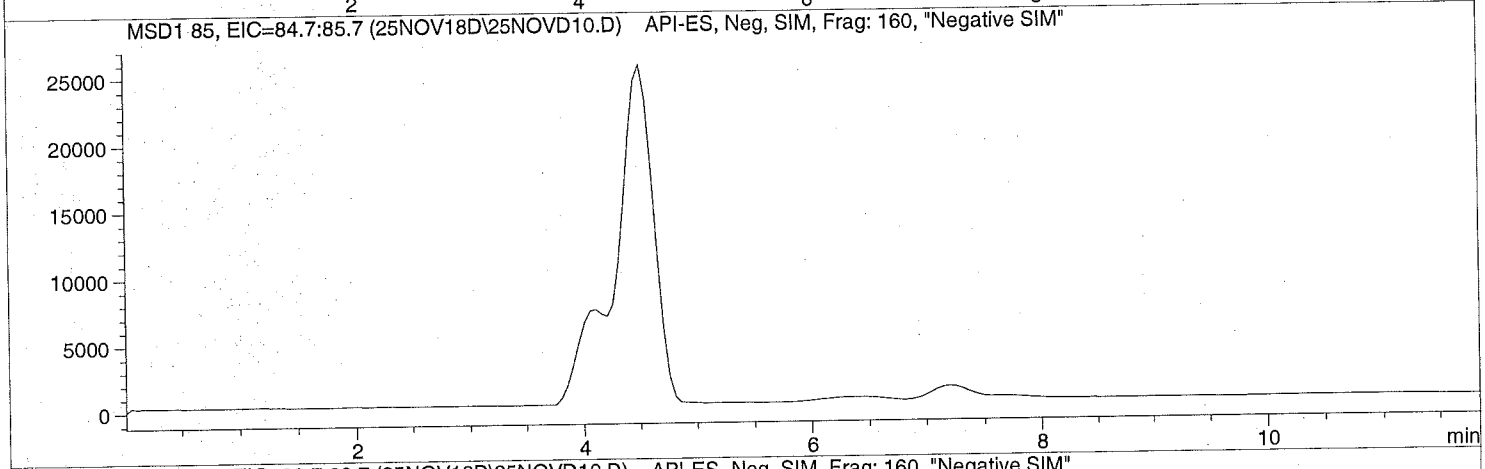
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD10.D Sample Name: 1831619005

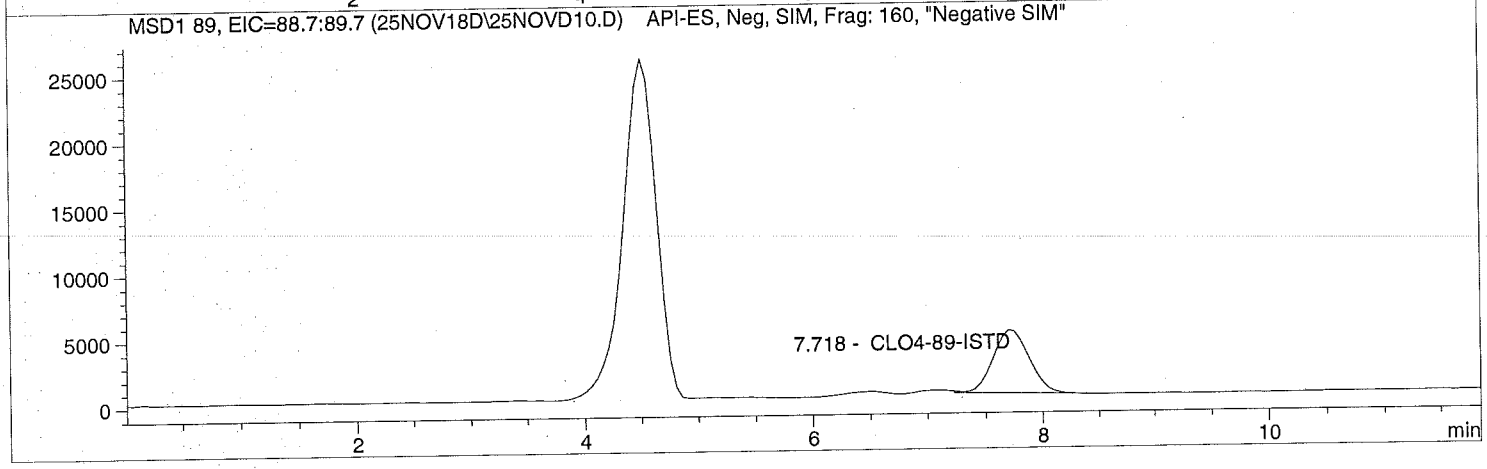
Injection Date:	11/25/2018 14:31:24	Seq Line:	10
Sample Name:	1831619005	Location:	Vial 80
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD10.D Sample Name: 1831619005

Injection Date:	11/25/2018 14:31:24	Seq Line:	10
Sample Name:	1831619005	Location:	Vial 80
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.718	BBA	105122.2	5.0000	CLO4-89-ISTD

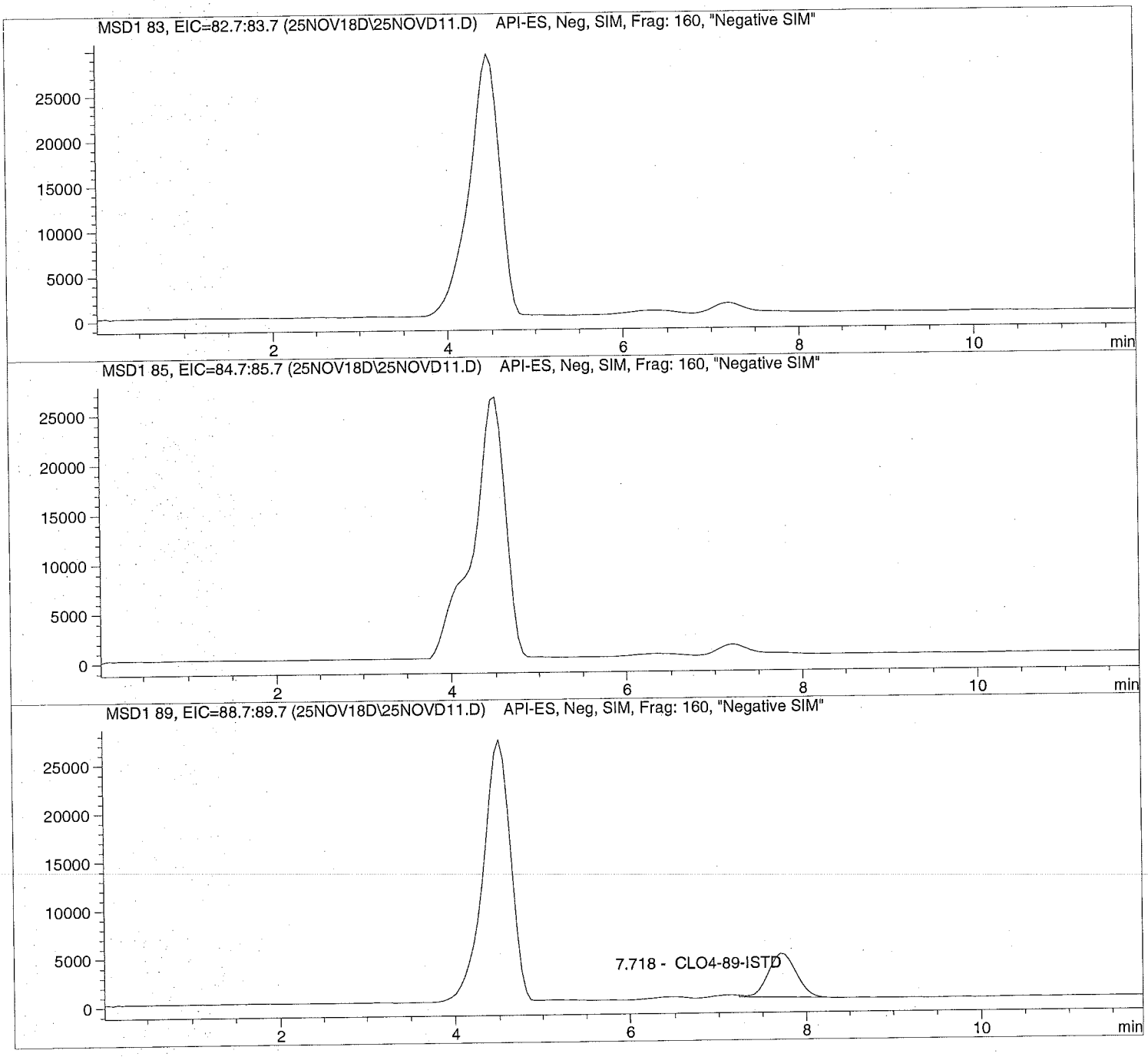
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD11.D Sample Name: 1831619006

Injection Date:	11/25/2018 14:45:19	Seq Line:	11
Sample Name:	1831619006	Location:	Vial 81
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD11.D Sample Name: 1831619006

Injection Date:	11/25/2018 14:45:19	Seq Line:	11
Sample Name:	1831619006	Location:	Vial 81
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method:	CLO4-AQN.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.718	BBA	99388.7	5.0000	CLO4-89-ISTD

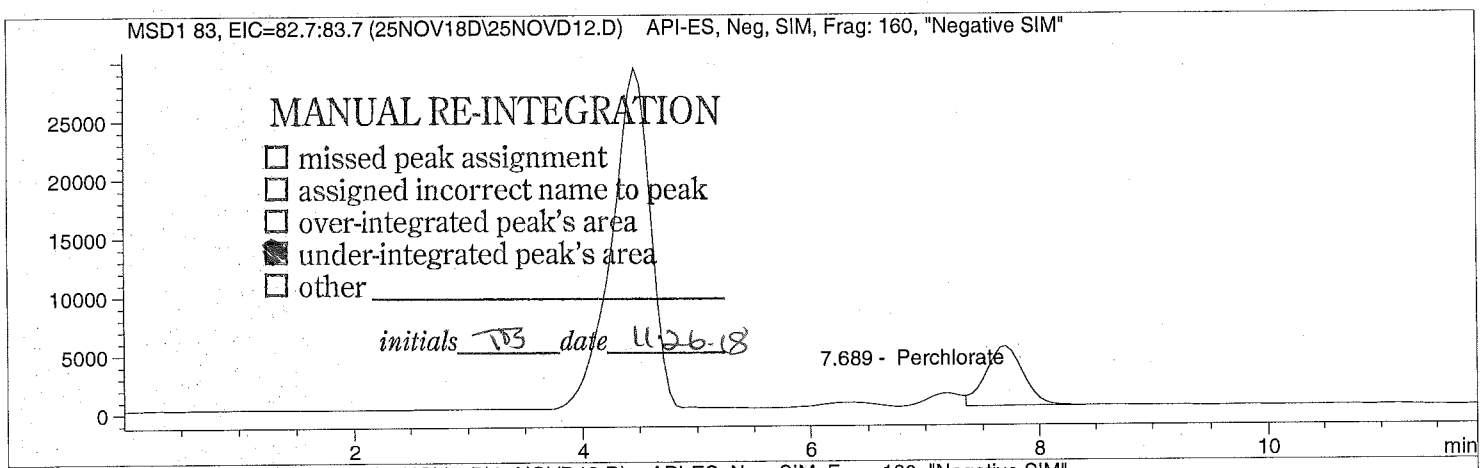
*** End of Report ***

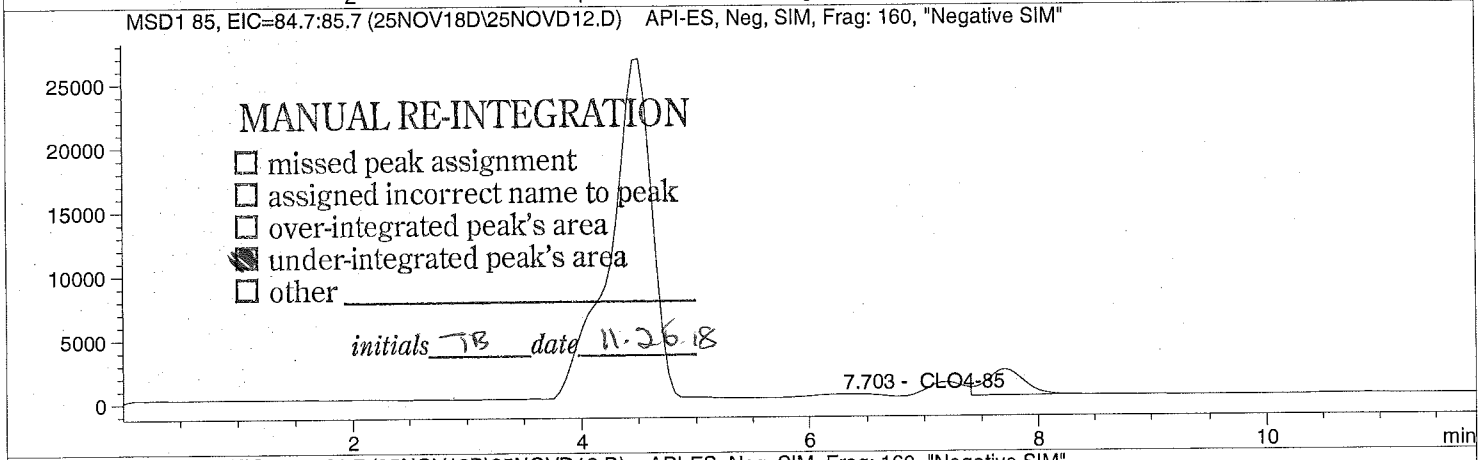
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD12.D Sample Name: 1831619007 MS

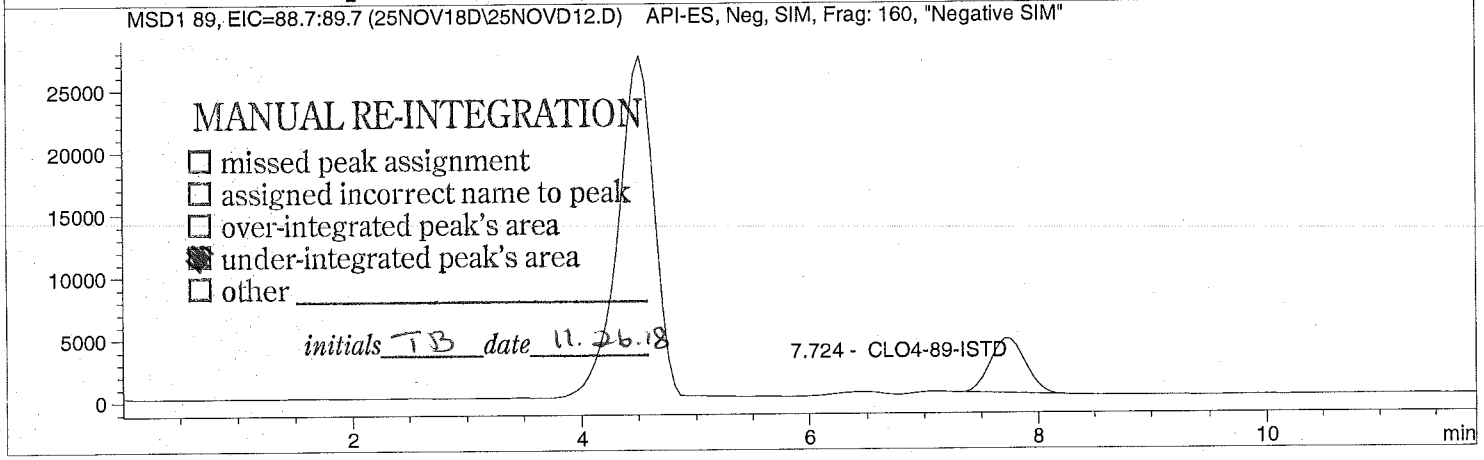
Injection Date:	11/25/2018 14:59:04	Seq Line:	12
Sample Name:	1831619007 MS	Location:	Vial 82
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD12.D Sample Name: 1831619007 MS

Injection Date:	11/25/2018 14:59:04	Seq Line:	12
Sample Name:	1831619007 MS	Location:	Vial 82
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.689	MF	114507.5	3.9231	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.703	FM	46893.0	5.2053	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.724	MM	94679.7	5.0000	CLO4-89-ISTD

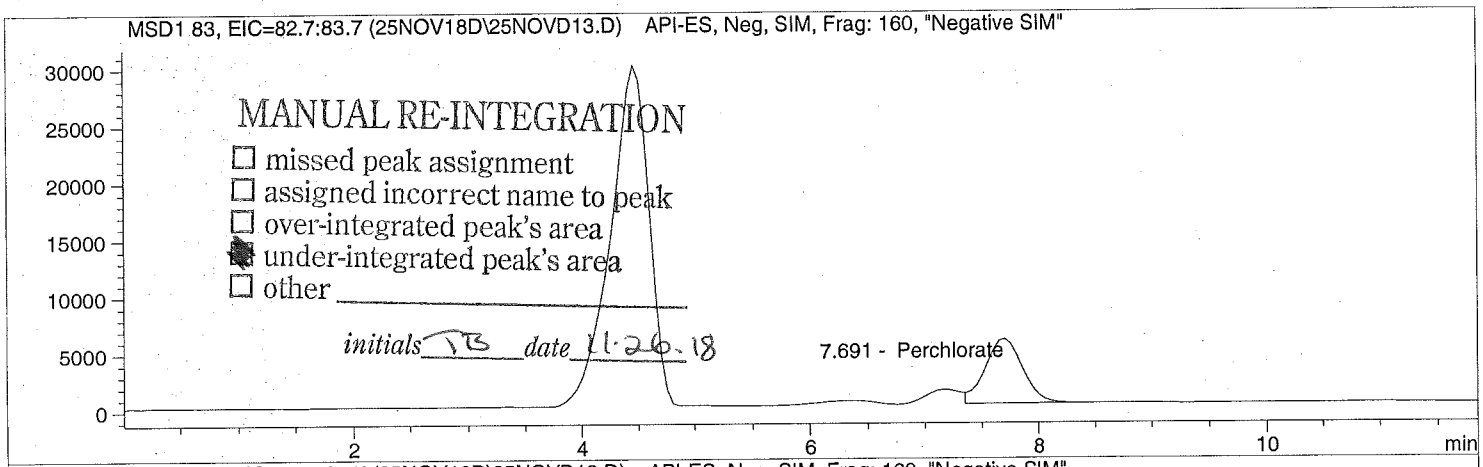
*** End of Report ***

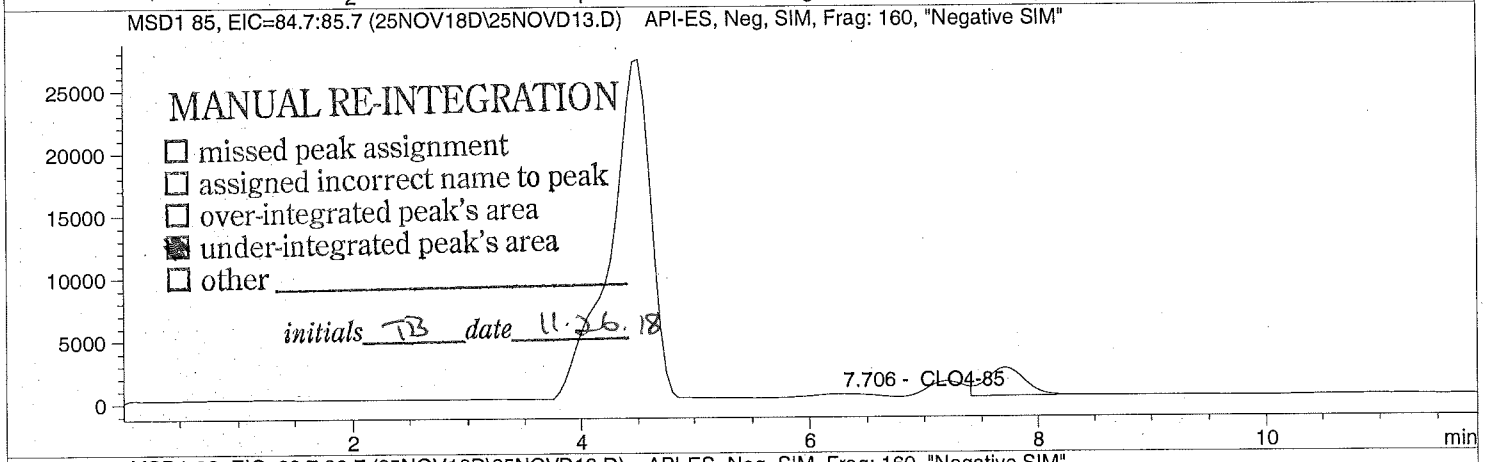
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD13.D Sample Name: 1831619008 MSD

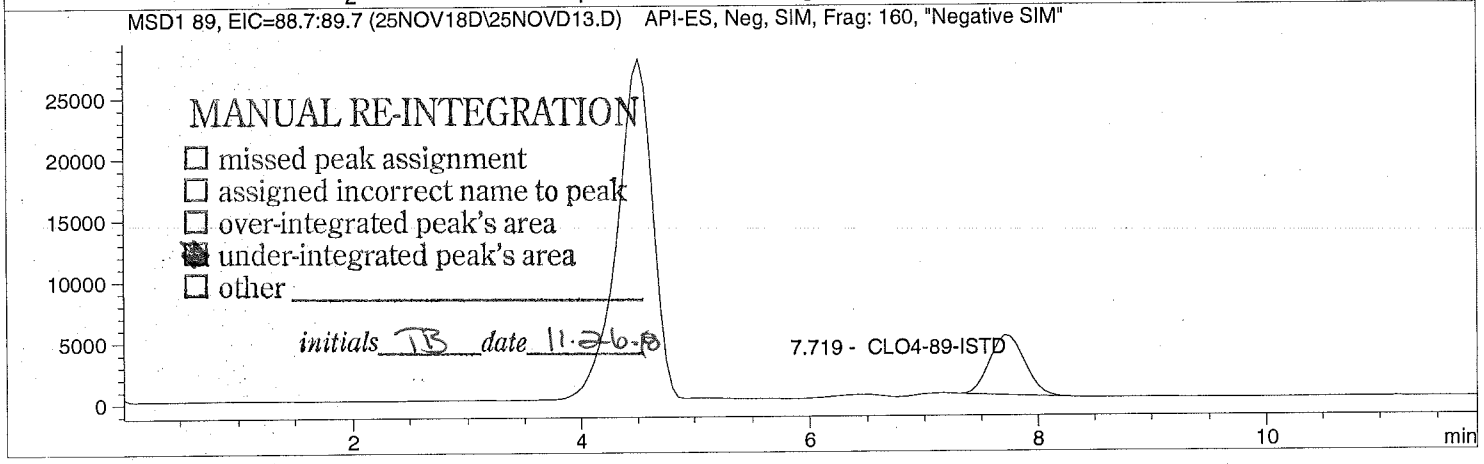
Injection Date:	11/25/2018 15:12:53	Seq Line:	13
Sample Name:	1831619008 MSD	Location:	Vial 83
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD13.D Sample Name: 1831619008 MSD

Injection Date:	11/25/2018 15:12:53	Seq Line:	13
Sample Name:	1831619008 MSD	Location:	Vial 83
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.691	FM	128041.8	3.9414	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.706	FM	53972.1	5.3792	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.719	MM	105348.4	5.0000	CLO4-89-ISTD

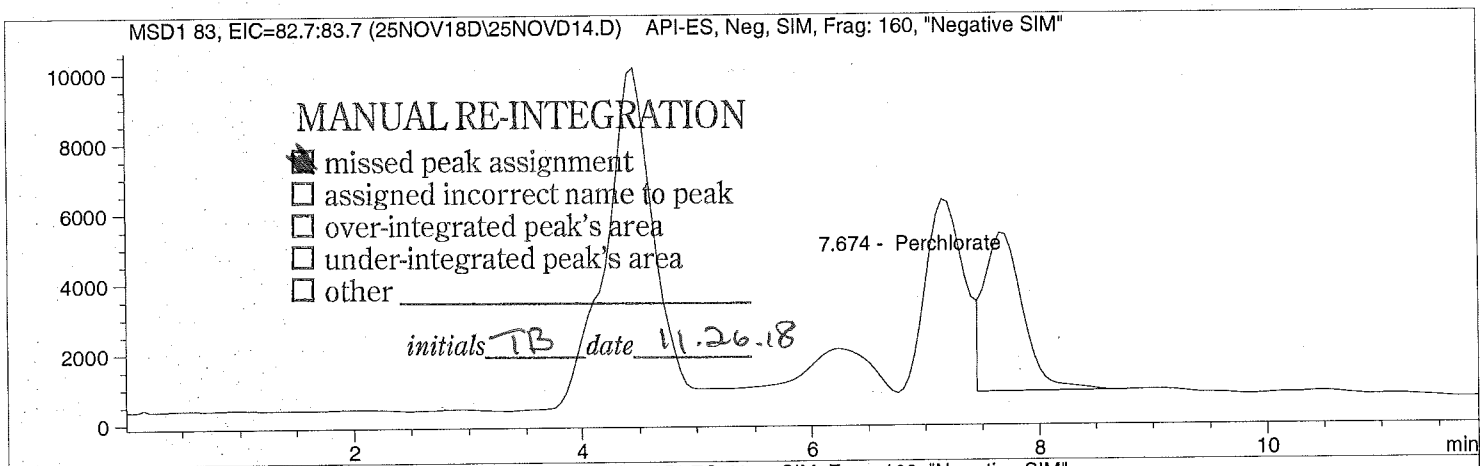
*** End of Report ***

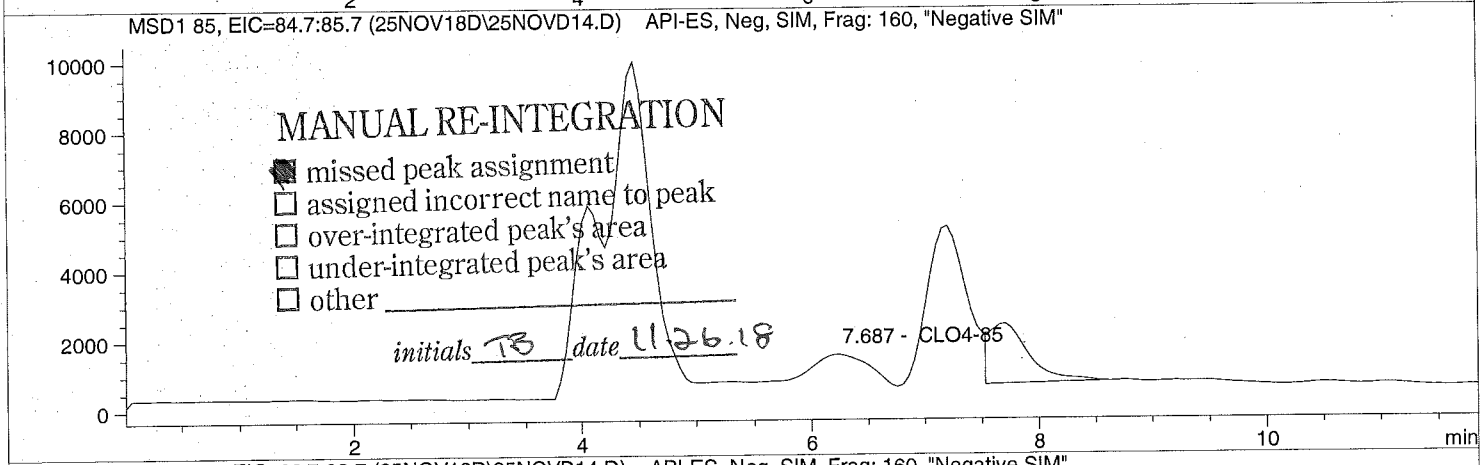
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD14.D Sample Name: 1831619009

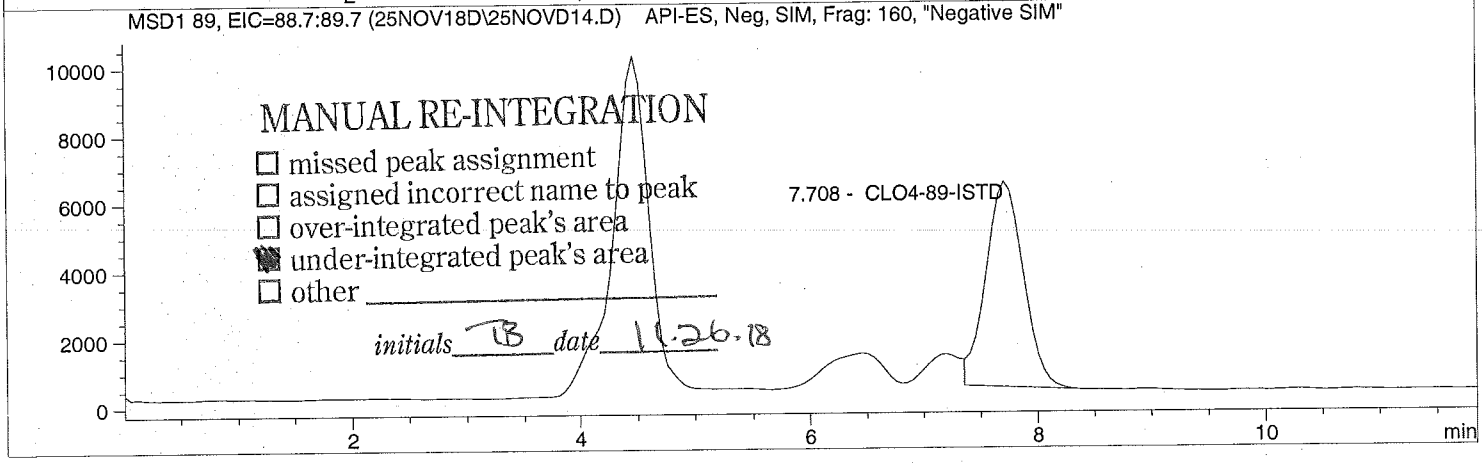
Injection Date:	11/25/2018 15:26:38	Seq Line:	14
Sample Name:	1831619009	Location:	Vial 84
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD14.D Sample Name: 1831619009

Injection Date:	11/25/2018 15:26:38	Seq Line:	14
Sample Name:	1831619009	Location:	Vial 84
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.674	FM	101861.9	2.5082	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.687	FM	39642.5	3.1060	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.708	FM	136385.1	5.0000	CLO4-89-ISTD

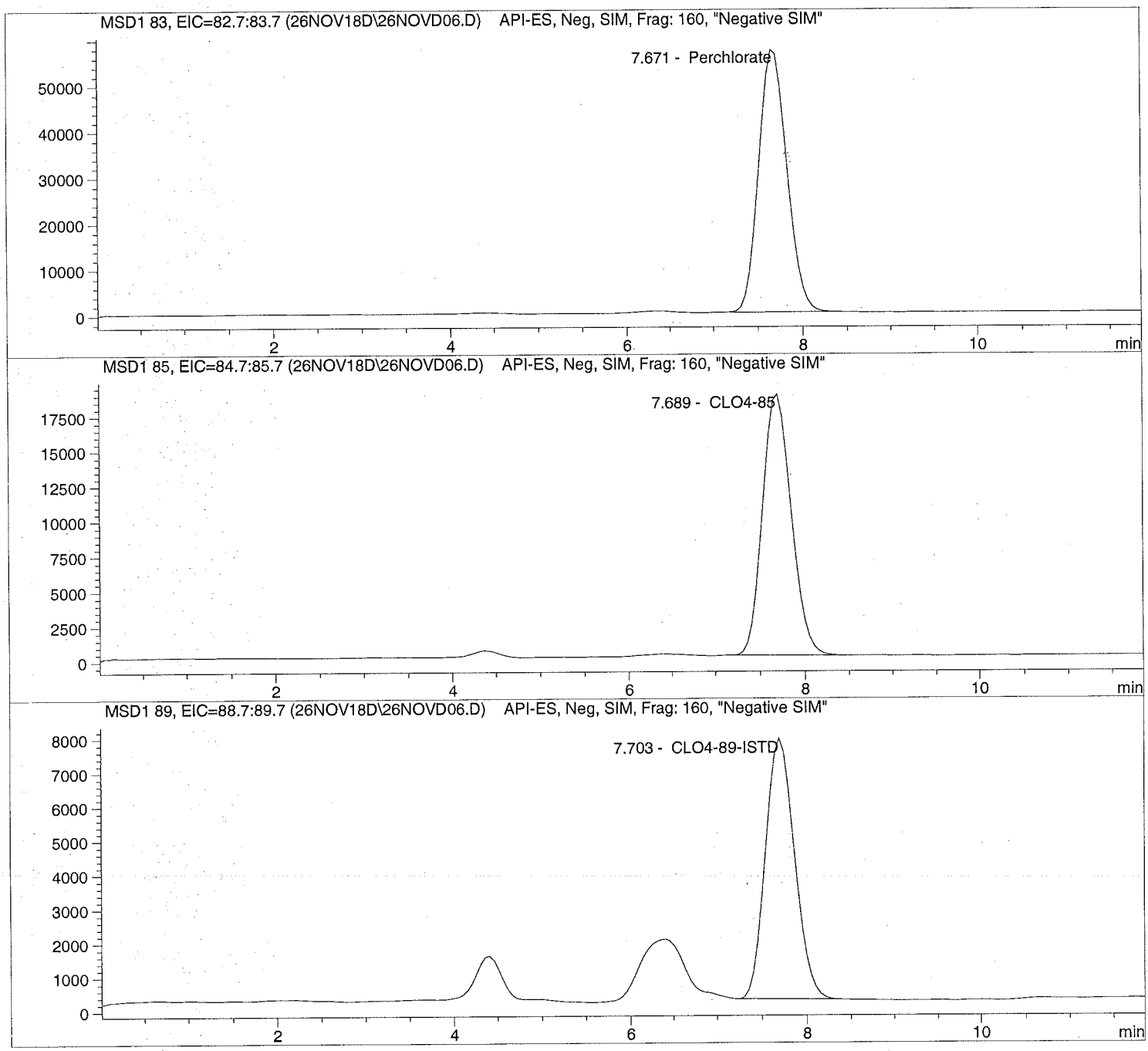
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\26NOV18D\26NOVD06.D Sample Name: 628729 CCV@25

Injection Date:	11/26/2018 10:13:17	Seq Line:	6
Sample Name:	628729 CCV@25	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\26NOV18D\26NOVD06.D Sample Name: 628729 CCV@25

Injection Date:	11/26/2018 10:13:17	Seq Line:	6
Sample Name:	628729 CCV@25	Location:	Vial 71
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	25.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.671	BBA	1259318.7	21.9119	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.689	BBA	416774.3	23.9243	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.703	PBA	172663.5	5.0000	CLO4-89-ISTD

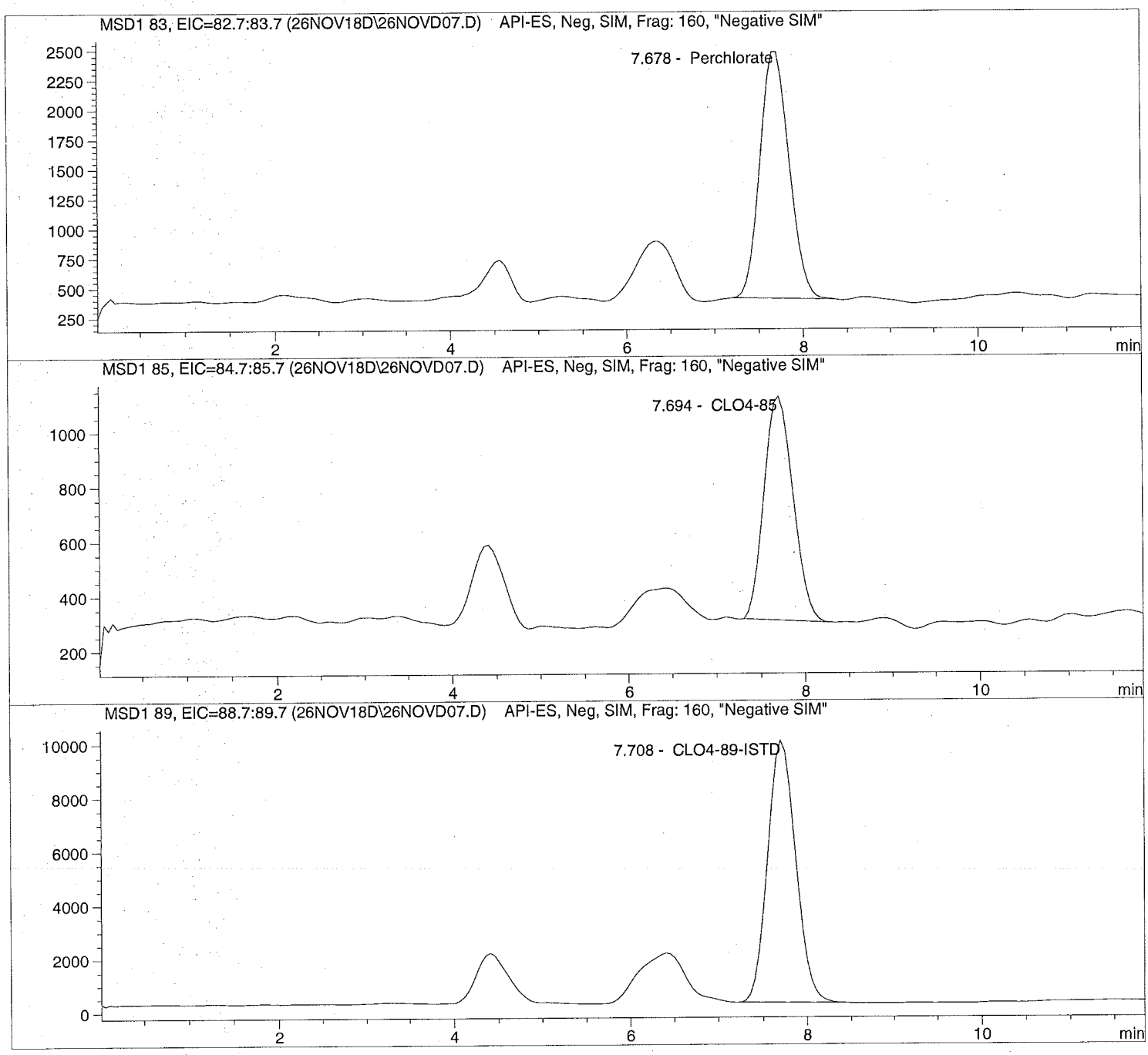
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\26NOV18D\26NOVD07.D Sample Name: 628730 LODV@1.

Injection Date:	11/26/2018 10:27:49	Seq Line:	7
Sample Name:	628730 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\26NOV18D\26NOVD07.D Sample Name: 628730 LODV@1.

Injection Date:	11/26/2018 10:27:49	Seq Line:	7
Sample Name:	628730 LODV@1.	Location:	Vial 72
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.678	PBA	47515.2	0.8869	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.694	PBA	18716.0	0.9895	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.708	PBA	216302.4	5.0000	CLO4-89-ISTD

*** End of Report ***

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data

Initial Calibration

atch Report: C:\HPCHEM\1\DATA\08OCT18I\08OCT18D.B

Batch Review Method:
C:\HPCHEM\1\METHODS\CLO4-DPR.M

['#' ==> Run has not been reprocessed with Batch Review Method
'*' ==> Run has been saved with batch file]

#	Sample	Location	Inj	SampleType	Run	Perchlorate Area	Perchlorate RT	Perchlorate Amount
#*	CLO4@ 1.0u	Vial 74	1	Control	4	9.40790e4	9.287	9.73826e-1
#*	CLO4@ 2.0u	Vial 75	1	Control	5	2.26957e5	9.259	2.19167
#*	CLO4@ 5.0u	Vial 76	1	Control	6	5.50307e5	9.208	4.80912
#*	CLO4@ 10.u	Vial 77	1	Control	7	1.07623e6	9.246	9.38291
#*	CLO4@ 25.u	Vial 78	1	Control	8	2.88097e6	9.175	25.83039
#*	CLO4@ 50.u	Vial 79	1	Control	9	6.29507e6	9.261	49.91981
#*	CLO4@ 75.u	Vial 80	1	Control	10	9.45737e6	9.236	74.88523
*	ICAL Verf@	Vial 81	1	Control	11	1.10069e6	9.244	9.38952

#	Sample	Location	Inj	SampleType	Run	CLO4-89-ISTD Area	CLO4-89-ISTD RT	CLO4-89-ISTD Amount
#*	CLO4@ 1.0u	Vial 74	1	Control	4	3.79545e5	9.314	5.00000
#*	CLO4@ 2.0u	Vial 75	1	Control	5	3.52582e5	9.297	5.00000
#*	CLO4@ 5.0u	Vial 76	1	Control	6	3.66805e5	9.223	5.00000
#*	CLO4@ 10.u	Vial 77	1	Control	7	3.56815e5	9.266	5.00000
#*	CLO4@ 25.u	Vial 78	1	Control	8	3.32340e5	9.196	5.00000
#*	CLO4@ 50.u	Vial 79	1	Control	9	3.59393e5	9.277	5.00000
#*	CLO4@ 75.u	Vial 80	1	Control	10	3.45193e5	9.253	5.00000
*	ICAL Verf@	Vial 81	1	Control	11	3.64657e5	9.264	5.00000

#	Sample	Location	Inj	SampleType	Run	CLO4-85 Area	CLO4-85 RT	CLO4-85 Amount
#*	CLO4@ 1.0u	Vial 74	1	Control	4	3.17987e4	9.316	9.60861e-1
#*	CLO4@ 2.0u	Vial 75	1	Control	5	7.05436e4	9.273	2.16955
#*	CLO4@ 5.0u	Vial 76	1	Control	6	1.69833e5	9.217	4.87565
#*	CLO4@ 10.u	Vial 77	1	Control	7	3.31565e5	9.259	9.58732
#*	CLO4@ 25.u	Vial 78	1	Control	8	8.62978e5	9.187	25.62680
#*	CLO4@ 50.u	Vial 79	1	Control	9	1.91847e6	9.278	49.74848
#*	CLO4@ 75.u	Vial 80	1	Control	10	2.93835e6	9.251	75.02646
*	ICAL Verf@	Vial 81	1	Control	11	3.27974e5	9.261	9.28908

*** End of Report ***

Method C:\HPCHEM\1\METHODS\CLO4-DPR.M

Calibration Table

Perchlorate

Calib. Data Modified : 10/9/2018 8:01:57 AM

Calculate : Internal Standard
Based on : Peak Area

Rel. Reference Window : 20.000 %
Abs. Reference Window : 0.000 min
Rel. Non-ref. Window : 20.000 %
Abs. Non-ref. Window : 0.000 min
Use Multiplier & Dilution Factor with ISTDs
Uncalibrated Peaks : not reported
Partial Calibration : No recalibration if peaks missing

Curve Type : Quadratic (some peaks differ, see below)
Origin : Ignored (some peaks differ, see below)
Weight : Linear (Amnt) (some peaks differ, see below)

Recalibration Settings:
Average Response : Average all calibrations
Average Retention Time: Floating Average New 75%

Calibration Report Options :
Printout of recalibrations within a sequence:
Calibration Table after Recalibration
Normal Report after Recalibration
If the sequence is done with bracketing:
Results of first cycle (ending previous bracket)

Default Sample ISTD Information (if not set in sample table):

ISTD #	ISTD Amount	Name
1	5.00000	CLO4-89-ISTD

Signal 1: MSD1 83, EIC=82.7:83.7
Signal 2: MSD1 85, EIC=84.7:85.7
Signal 3: MSD1 89, EIC=88.7:89.7

RetTime [min]	Sig	Lvl	Amount	Area	Amt/Area	Ref	Grp	Name
9.287	1	1	1.00000	9.40790e4	1.06294e-5	1		Perchlorate
		2	2.00000	2.26957e5	8.81224e-6			
		3	5.00000	5.50307e5	9.08584e-6			
		4	10.00000	1.07623e6	9.29172e-6			
		5	25.00000	2.88097e6	8.67764e-6			
		6	50.00000	6.29507e6	7.94272e-6			
		7	75.00000	9.45737e6	7.93033e-6			
9.314	3	1	5.00000	3.79545e5	1.31737e-5	+I1		CLO4-89-ISTD
		2	5.00000	3.52582e5	1.41811e-5			
		3	5.00000	3.66805e5	1.36312e-5			
		4	5.00000	3.56815e5	1.40129e-5			
		5	5.00000	3.32340e5	1.50448e-5			
		6	5.00000	3.59393e5	1.39124e-5			
		7	5.00000	3.45193e5	1.44847e-5			
9.316	2	1	1.00000	3.17987e4	3.14479e-5	1		CLO4-85
		2	2.00000	7.05436e4	2.83513e-5			
		3	5.00000	1.69833e5	2.94406e-5			
		4	10.00000	3.31565e5	3.01600e-5			
		5	25.00000	8.62978e5	2.89695e-5			
		6	50.00000	1.91847e6	2.60625e-5			

[ethod C:\HPCHEM\1\METHODS\CLO4-DPR.M

RetTime [min]	Sig	Lvl	Amount	Area	Amt/Area	Ref	Grp	Name
		7	75.00000	2.93835e6	2.55246e-5			

More compound-specific settings:

Compound: Perchlorate
- Time Window : From 7.196 min To 11.196 min
- Curve Type : Quadratic
- Origin : Ignored
- Calibration Level Weights:/
  - Level 1 : 1
  - Level 2 : 0.5
  - Level 3 : 0.2
  - Level 4 : 0.1
  - Level 5 : 0.04
  - Level 6 : 0.02
  - Level 7 : 0.013333

Compound: CLO4-89-ISTD
- Time Window : From 7.207 min To 11.192 min
- Curve Type : Linear
- Origin : Included
- Calibration Level Weights:/
  - Level 1 : 1
  - Level 2 : 1
  - Level 3 : 1
  - Level 4 : 1
  - Level 5 : 1
  - Level 6 : 1
  - Level 7 : 1

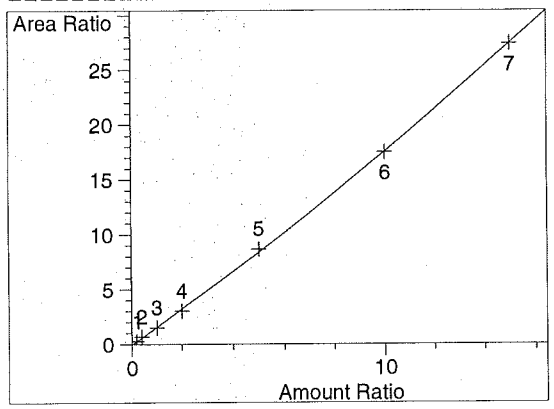
Compound: CLO4-85
- Time Window : From 7.211 min To 11.211 min
- Curve Type : Quadratic
- Origin : Ignored
- Calibration Level Weights:/
  - Level 1 : 1
  - Level 2 : 0.5
  - Level 3 : 0.2
  - Level 4 : 0.1
  - Level 5 : 0.04
  - Level 6 : 0.02
  - Level 7 : 0.013333

Peak Sum Table

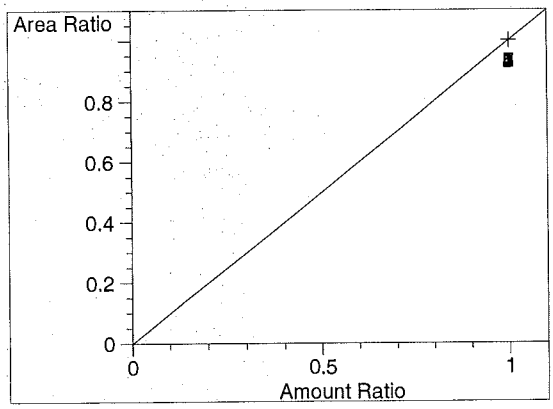
No Entries in table

Method C:\HPCHEM\1\METHODS\CLO4-DPR.M

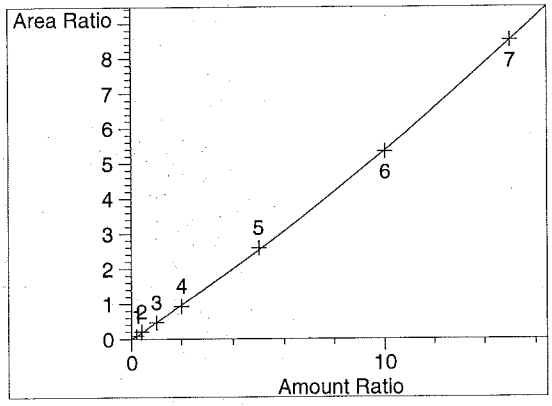
Calibration Curves



Perchlorate at exp. RT: 9.287
MSD1 83, EIC=82.7:83.7
Correlation: 0.99971
Residual Std. Dev.: 0.16701
Formula: $y = ax^2 + bx + c$
a: 1.45482e-2
b: 1.61590
c: -6.73998e-2
x: Amount Ratio
y: Area Ratio
Calibration Level Weights:
Level 1 : 1
Level 2 : 0.5
Level 3 : 0.2
Level 4 : 0.1
Level 5 : 0.04
Level 6 : 0.02
Level 7 : 0.013333



CLO4-89-ISTD at exp. RT: 9.314
MSD1 89, EIC=88.7:89.7
Correlation: 1.00000
Residual Std. Dev.: 0.00000
Formula: $y = mx + b$
m: 1.00000
b: 0.00000
x: Amount Ratio
y: Area Ratio
Calibration Level Weights:
Level 1 : 1
Level 2 : 1
Level 3 : 1
Level 4 : 1
Level 5 : 1
Level 6 : 1
Level 7 : 1



CLO4-85 at exp. RT: 9.316
MSD1 85, EIC=84.7:85.7
Correlation: 0.99984
Residual Std. Dev.: 0.03901
Formula: $y = ax^2 + bx + c$
a: 6.03220e-3
b: 4.77309e-1
c: -8.16718e-3
x: Amount Ratio
y: Area Ratio
Calibration Level Weights:
Level 1 : 1
Level 2 : 0.5
Level 3 : 0.2
Level 4 : 0.1
Level 5 : 0.04
Level 6 : 0.02
Level 7 : 0.013333

equence: C:\HPCHEM\1\SEQUENCE\CLO4\2018\OCT\08OCT18I.S

Sequence Table:

Method and Injection Info Part:

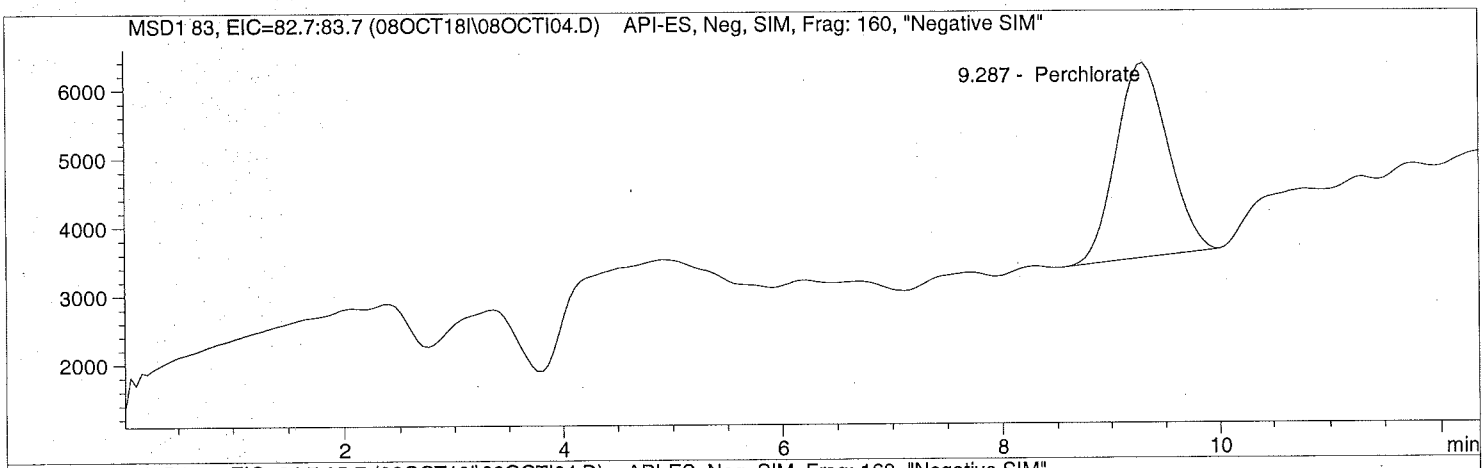
Line	Location	SampleName	Method	Inj	SampleType	InjVolume	DataFile
1	Vial 71	CLO4@ .10ug/L	CLO4-AQN	1	Ctrl Samp		
2	Vial 72	CLO4@ .20ug/L	CLO4-AQN	1	Ctrl Samp		
3	Vial 73	CLO4@ 0.5ug/L	CLO4-AQN	1	Ctrl Samp		
4	Vial 74	CLO4@ 1.0ug/L	CLO4-AQN	1	Ctrl Samp		
5	Vial 75	CLO4@ 2.0ug/L	CLO4-AQN	1	Ctrl Samp		
6	Vial 76	CLO4@ 5.0ug/L	CLO4-AQN	1	Ctrl Samp		
7	Vial 77	CLO4@ 10.ug/L	CLO4-AQN	1	Ctrl Samp		
8	Vial 78	CLO4@ 25.ug/L	CLO4-AQN	1	Ctrl Samp		
9	Vial 79	CLO4@ 50.ug/L	CLO4-AQN	1	Ctrl Samp		
10	Vial 80	CLO4@ 75.ug/L	CLO4-AQN	1	Ctrl Samp		
11	Vial 81	ICAL Verf@10ug/L	CLO4-AQN	1	Ctrl Samp		

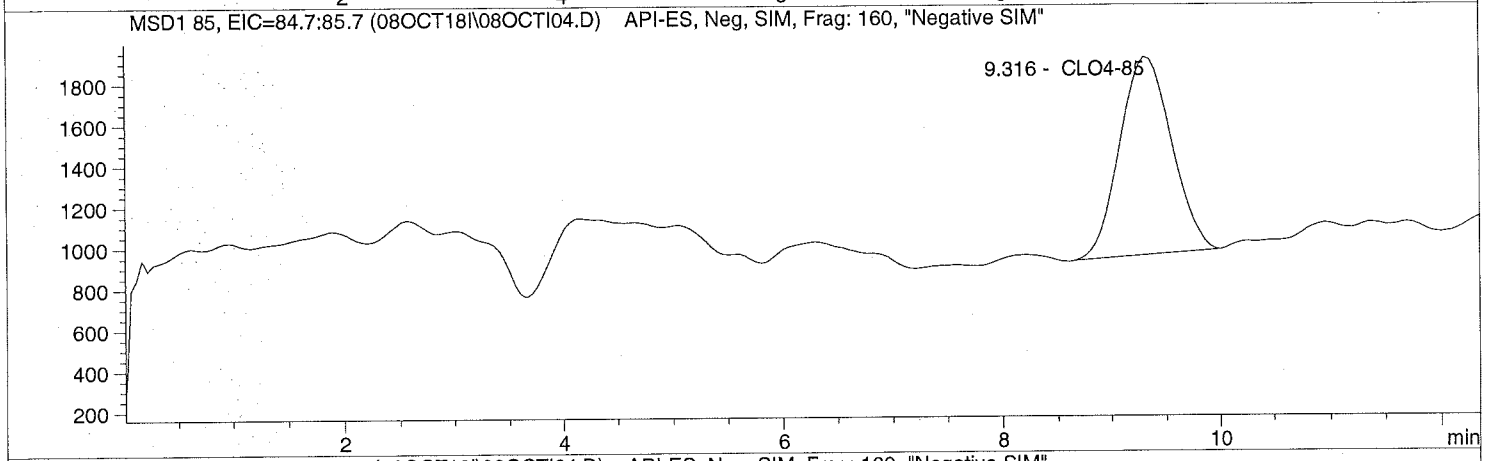
Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI04.D Sample Name: CLO4@ 1.0ug/L

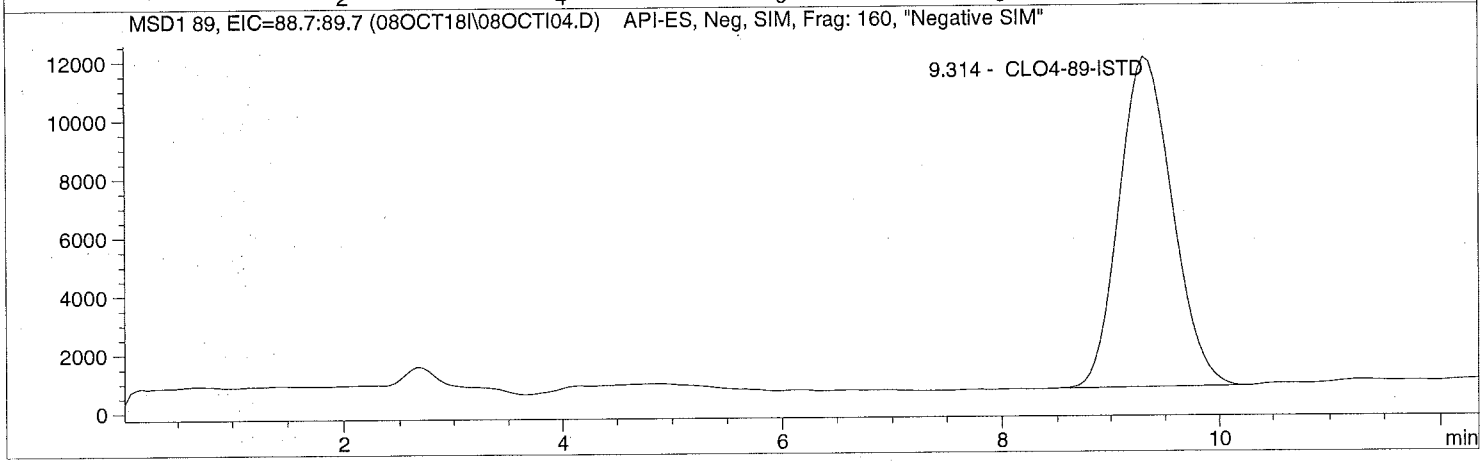
Injection Date:	10/08/2018 11:37:35	Seq Line:	4
Sample Name:	CLO4@ 1.0ug/L	Location:	Vial 74
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI04.D Sample Name: CLO4@ 1.0ug/L

Injection Date:	10/08/2018 11:37:35	Seq Line:	4
Sample Name:	CLO4@ 1.0ug/L	Location:	Vial 74
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method:	CLO4-AQN.M
Analysis Method:	C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed:	10/9/2018 08:22:51

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Tue, 9. Oct. 2018, 08:01:57 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.287	PBA	94079.0	0.9738	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.316	PBA	31798.7	0.9609	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.314	PBA	379544.7	5.0000	CLO4-89-ISTD

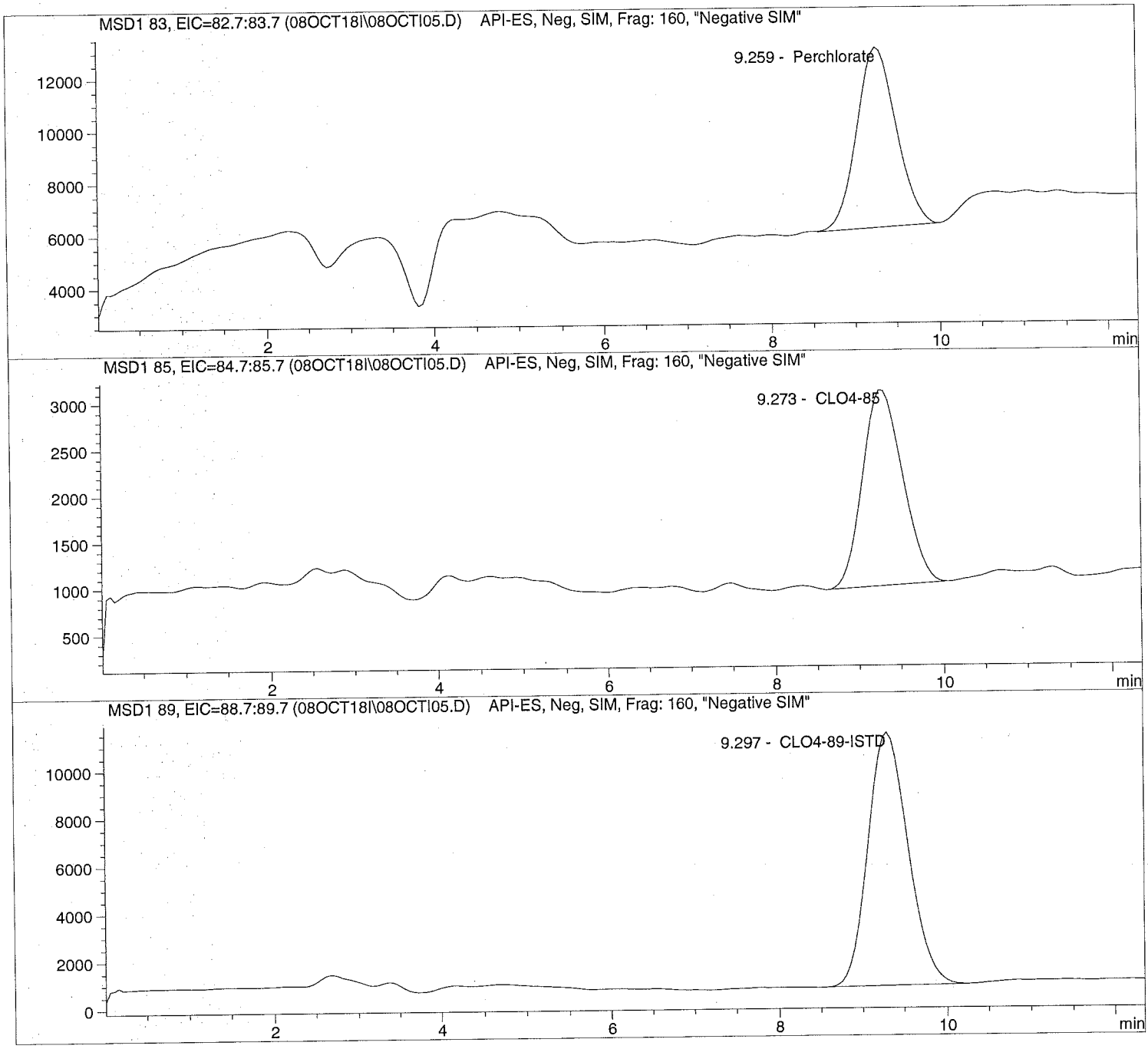
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI05.D Sample Name: CLO4@ 2.0ug/L

Injection Date:	10/08/2018 11:51:45	Seq Line:	5
Sample Name:	CLO4@ 2.0ug/L	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI05.D Sample Name: CLO4@ 2.0ug/L

Injection Date:	10/08/2018 11:51:45	Seq Line:	5
Sample Name:	CLO4@ 2.0ug/L	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Tue, 9. Oct. 2018, 08:01:57 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	2.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.259	BBA	226957.1	2.1917	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.273	PBA	70543.6	2.1695	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.297	PBA	352581.8	5.0000	CLO4-89-ISTD

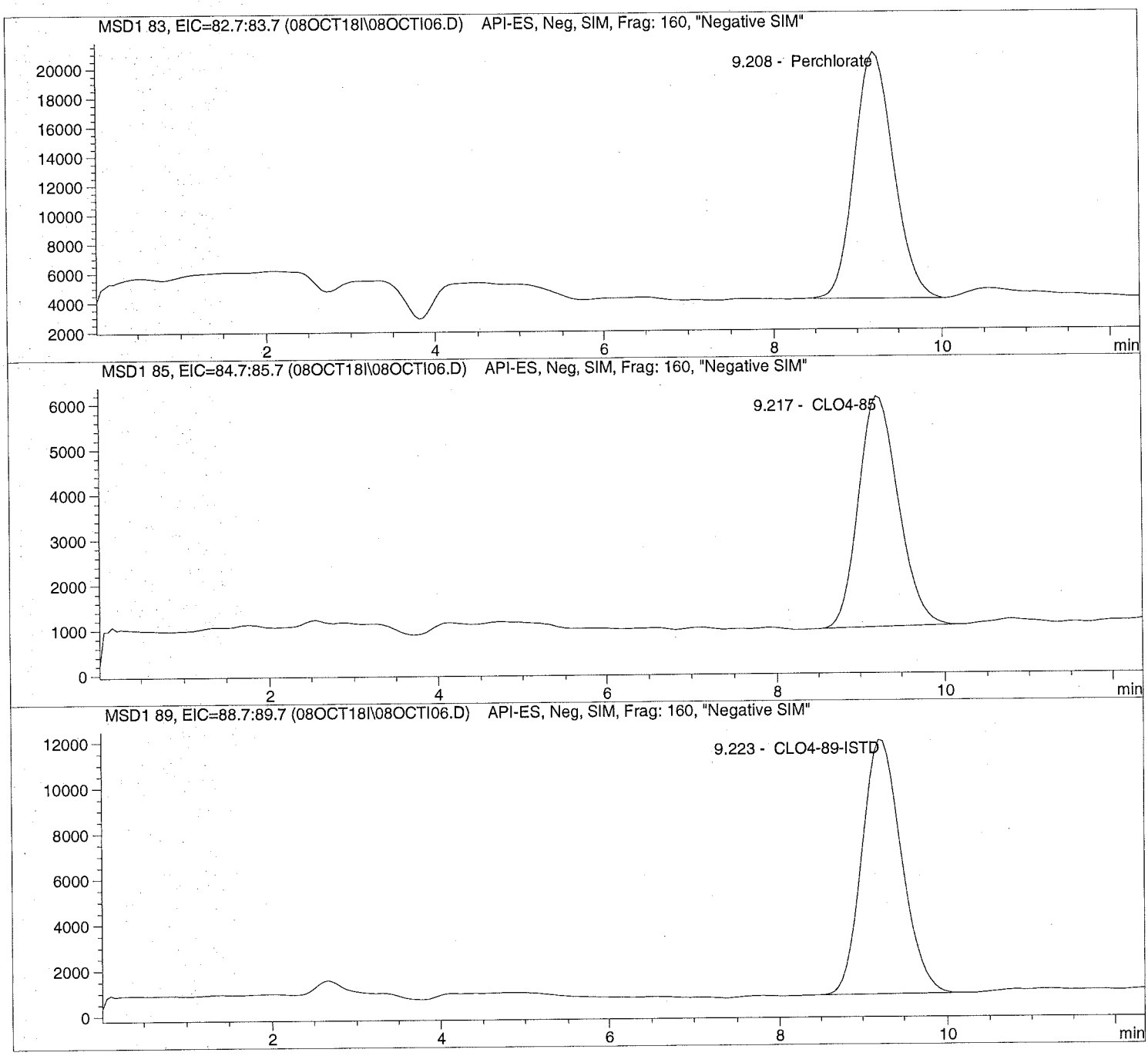
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI06.D Sample Name: CLO4@ 5.0ug/L

Injection Date:	10/08/2018 12:05:59	Seq Line:	6
Sample Name:	CLO4@ 5.0ug/L	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI06.D Sample Name: CLO4@ 5.0ug/L

Injection Date:	10/08/2018 12:05:59	Seq Line:	6
Sample Name:	CLO4@ 5.0ug/L	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Tue, 9. Oct. 2018, 08:01:57 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	5.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.208	BBA	550306.9	4.8091	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.217	PBA	169833.3	4.8757	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.223	PBA	366804.8	5.0000	CLO4-89-ISTD

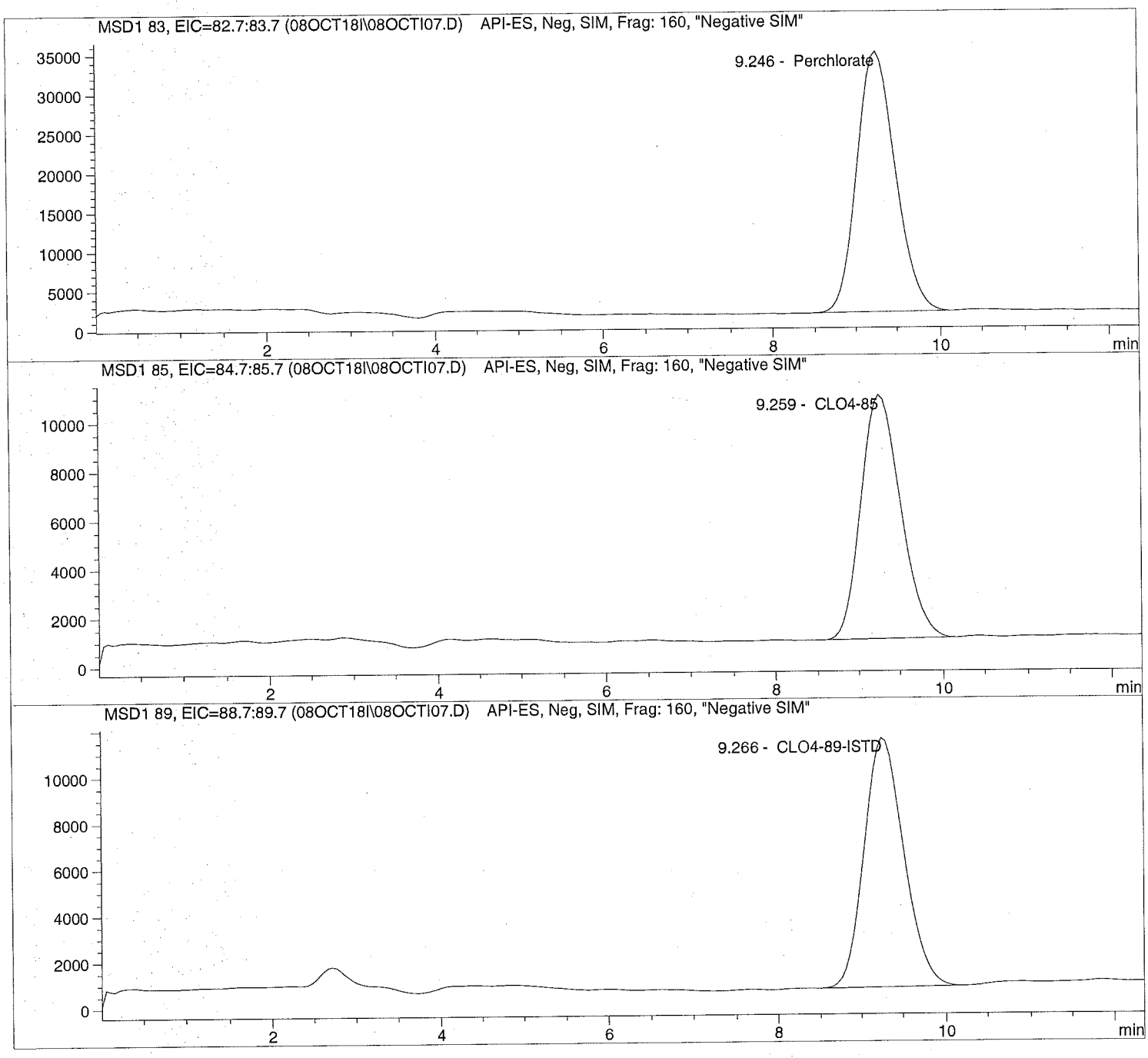
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI07.D Sample Name: CLO4@ 10.ug/L

Injection Date:	10/08/2018 12:20:10	Seq Line:	7
Sample Name:	CLO4@ 10.ug/L	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI07.D Sample Name: CLO4@ 10.ug/L

Injection Date:	10/08/2018 12:20:10	Seq Line:	7
Sample Name:	CLO4@ 10.ug/L	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Tue, 9. Oct. 2018, 08:01:57 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	10.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.246	PBA	1076227.4	9.3829	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.259	PBA	331564.9	9.5873	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.266	PBA	356815.3	5.0000	CLO4-89-ISTD

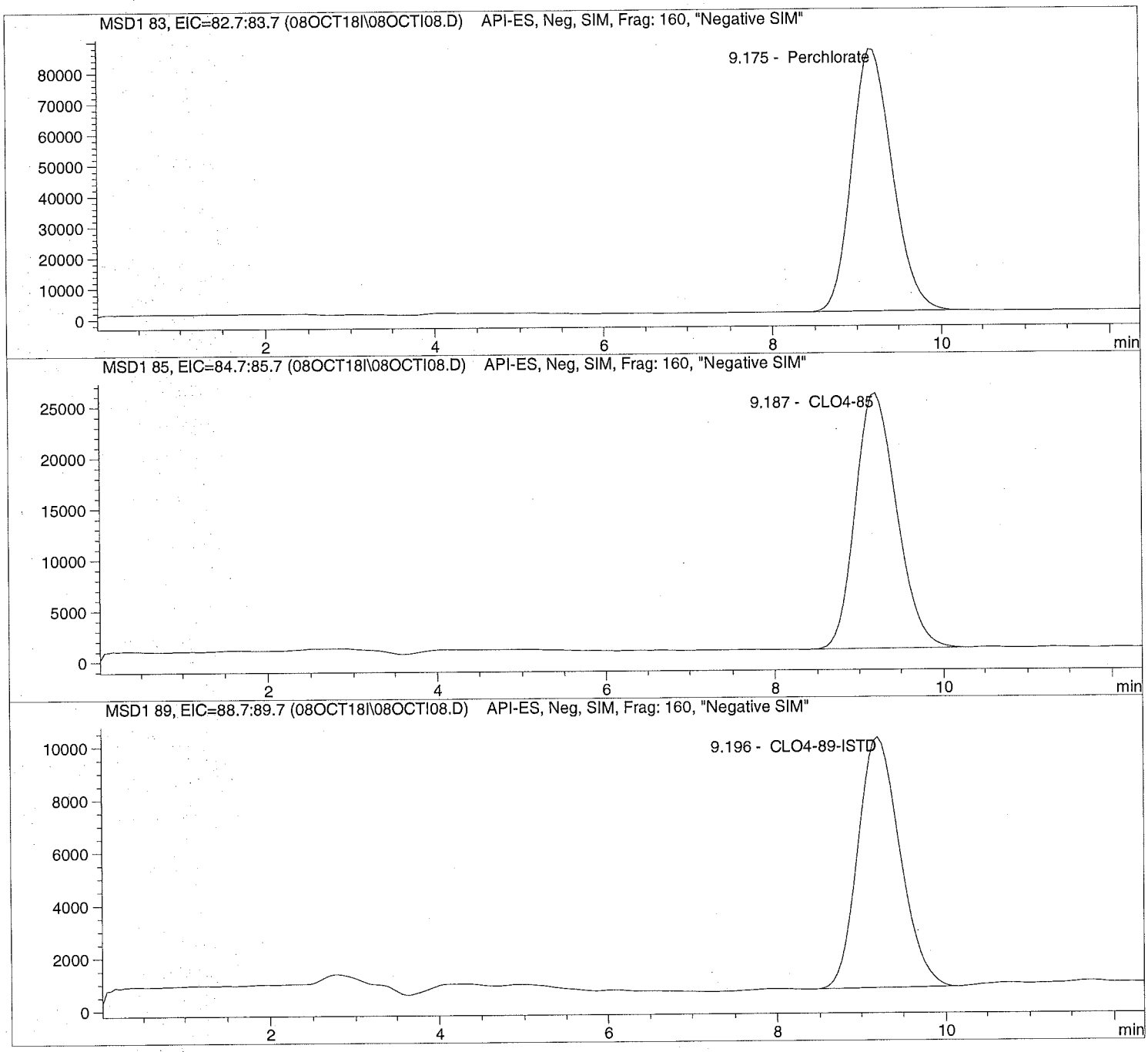
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI08.D Sample Name: CLO4@ 25.ug/L

Injection Date:	10/08/2018 12:34:24	Seq Line:	8
Sample Name:	CLO4@ 25.ug/L	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI08.D Sample Name: CLO4@ 25.ug/L

Injection Date:	10/08/2018 12:34:24	Seq Line:	8
Sample Name:	CLO4@ 25.ug/L	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Tue, 9. Oct. 2018, 08:01:57 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	25.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.175	PBA	2880966.0	25.8304	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.187	PBA	862978.0	25.6268	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.196	PBA	332339.7	5.0000	CLO4-89-ISTD

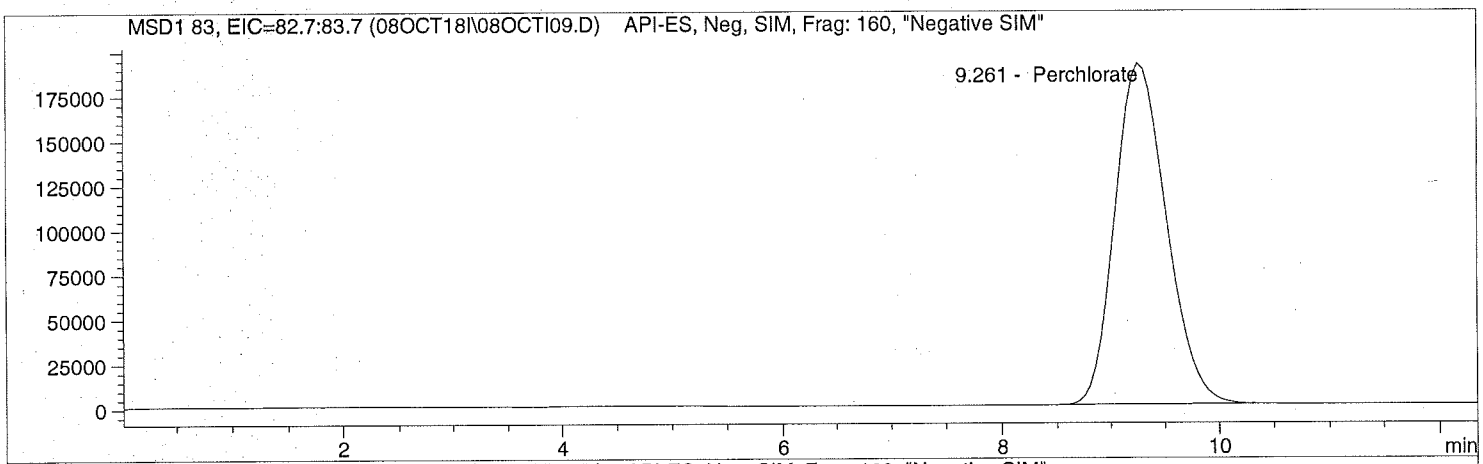
*** End of Report ***

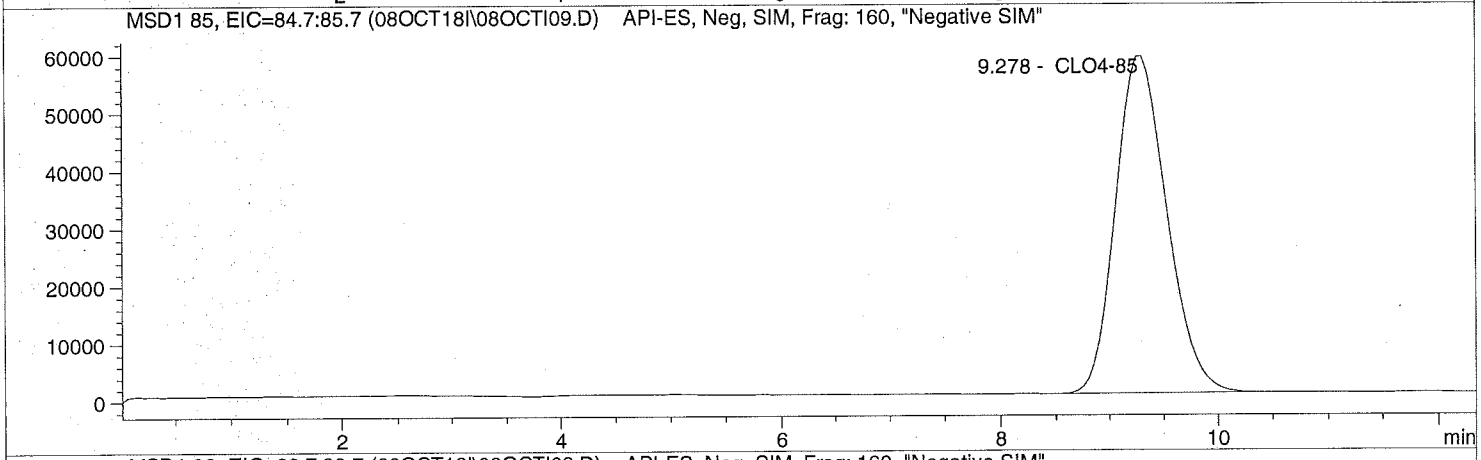
Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI09.D Sample Name: CLO4@ 50.ug/L

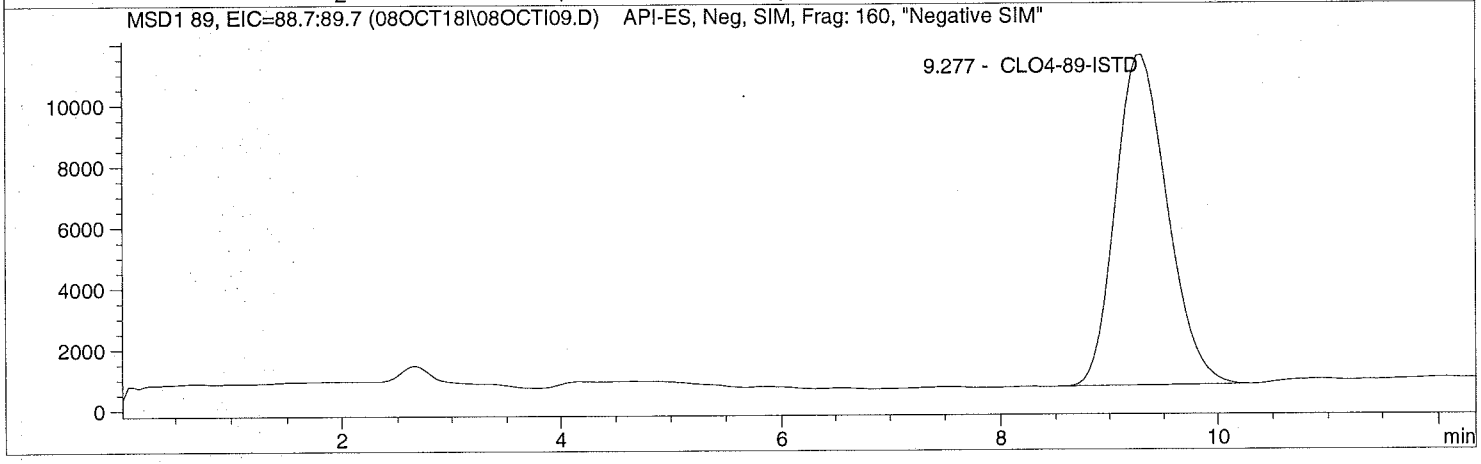
Injection Date:	10/08/2018 12:48:34	Seq Line:	9
Sample Name:	CLO4@ 50.ug/L	Location:	Vial 79
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI09.D Sample Name: CLO4@ 50.ug/L

Injection Date:	10/08/2018 12:48:34	Seq Line:	9
Sample Name:	CLO4@ 50.ug/L	Location:	Vial 79
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Tue, 9. Oct. 2018, 08:01:57 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	50.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.261	PBA	6295070.5	49.9198	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.278	PBA	1918466.9	49.7485	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.277	PBA	359392.8	5.0000	CLO4-89-ISTD

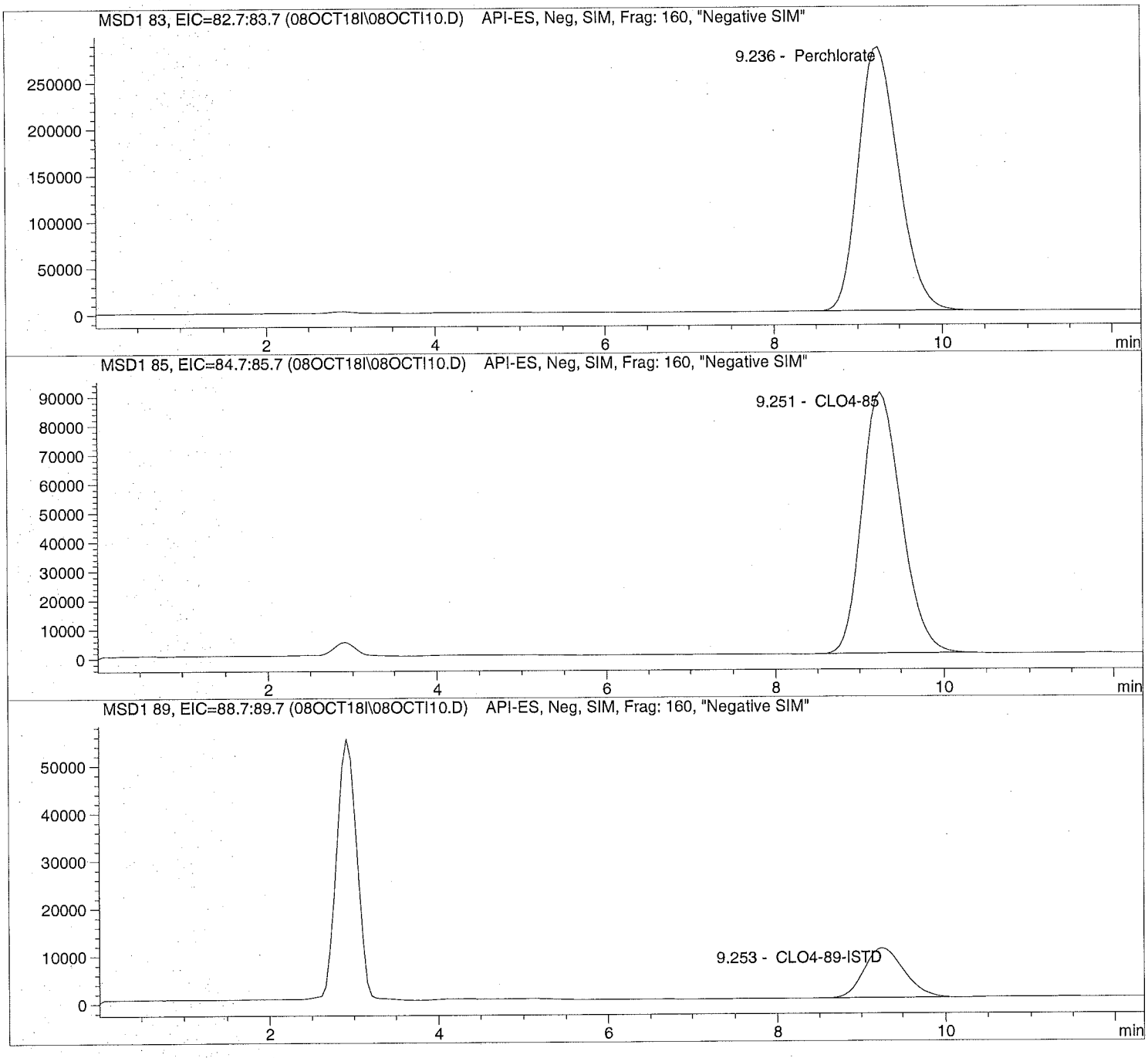
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI10.D Sample Name: CLO4@ 75.ug/L

Injection Date:	10/08/2018 13:02:48	Seq Line:	10
Sample Name:	CLO4@ 75.ug/L	Location:	Vial 80
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI10.D Sample Name: CLO4@ 75.ug/L

Injection Date:	10/08/2018 13:02:48	Seq Line:	10
Sample Name:	CLO4@ 75.ug/L	Location:	Vial 80
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Tue, 9. Oct. 2018, 08:01:57 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	75.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.236	PBA	9457367.0	74.8852	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.251	PBA	2938347.5	75.0265	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.253	PBA	345192.7	5.0000	CLO4-89-ISTD

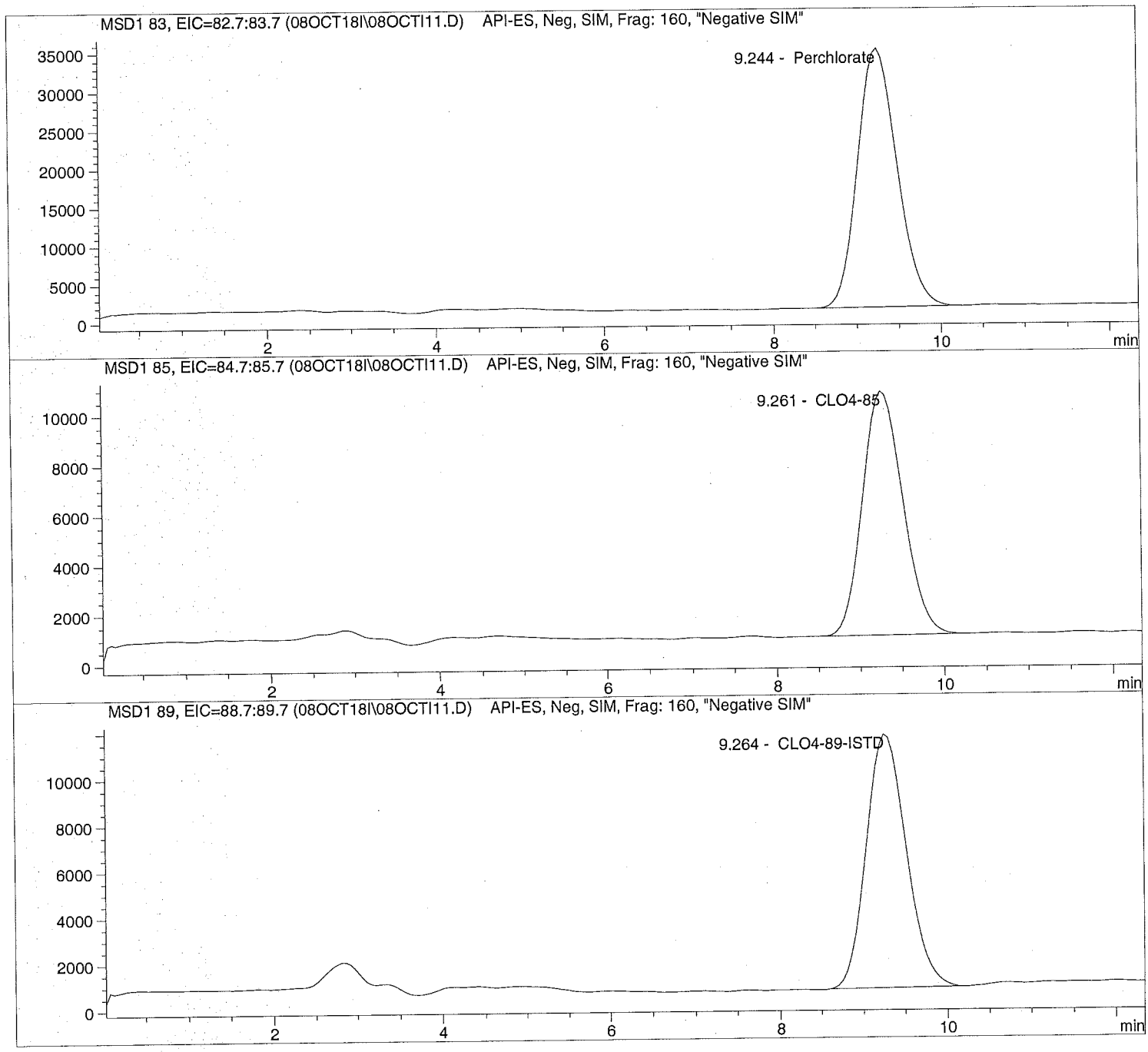
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI11.D Sample Name: ICAL Verf@10ug/L

Injection Date:	10/08/2018 13:17:00	Seq Line:	11
Sample Name:	ICAL Verf@10ug/L	Location:	Vial 81
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\08OCT18I\08OCTI11.D Sample Name: ICAL Verf@10ug/L

Injection Date:	10/08/2018 13:17:00	Seq Line:	11
Sample Name:	ICAL Verf@10ug/L	Location:	Vial 81
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	25 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 10/9/2018 08:22:51

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Tue, 9. Oct. 2018, 08:01:57 am
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	10.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.244	PBA	1100685.7	9.3895	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.261	PBA	327974.4	9.2891	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.264	PBA	364657.2	5.0000	CLO4-89-ISTD

*** End of Report ***

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data

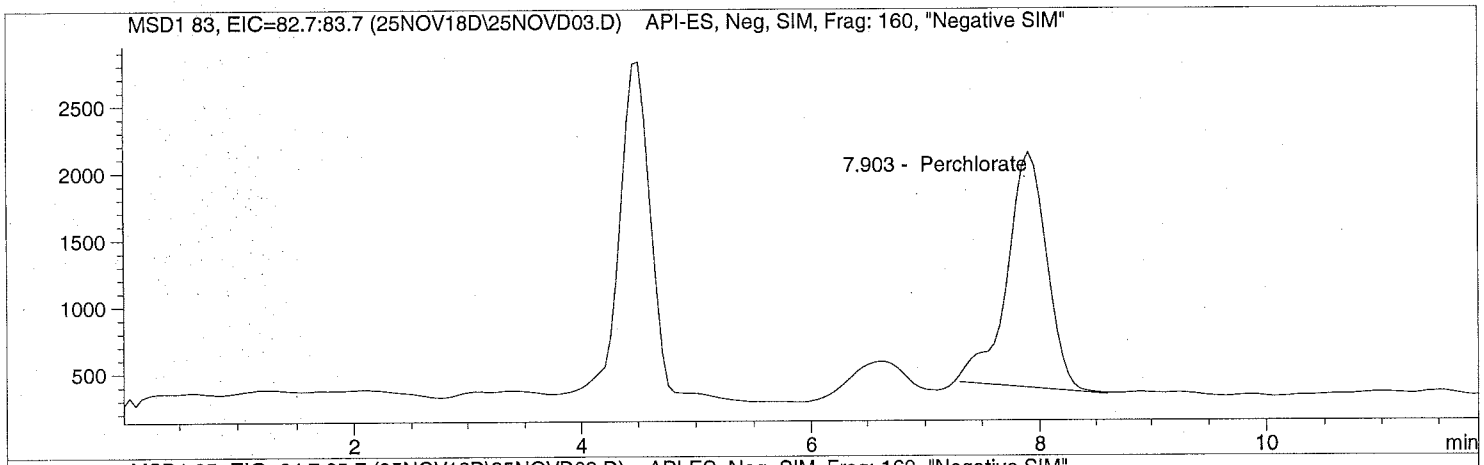
Unmodified

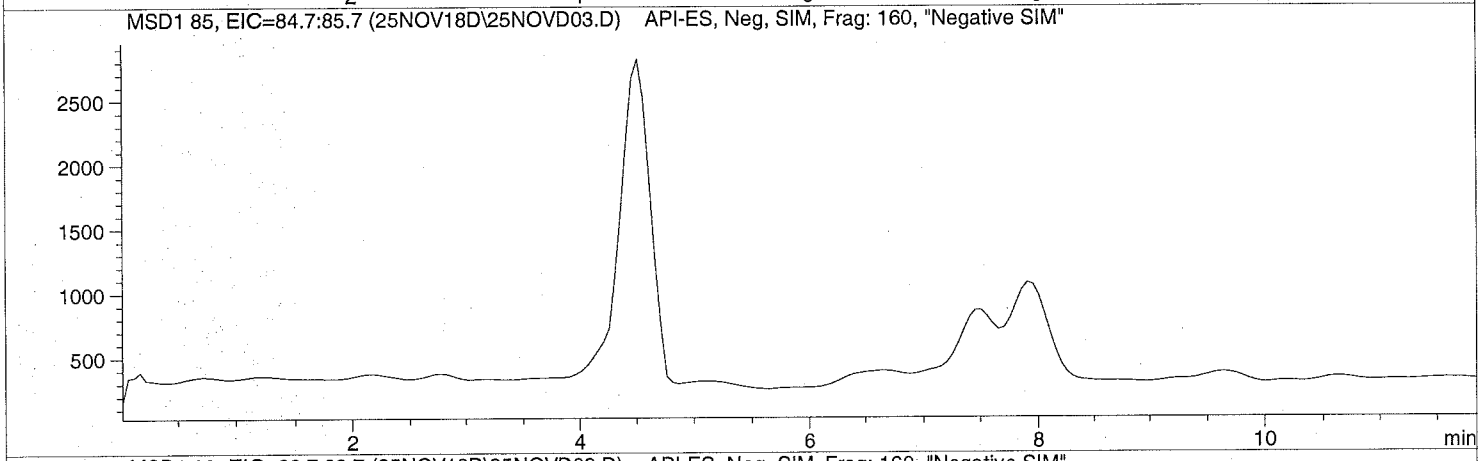
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD03.D Sample Name: 628726 ICS@1.0

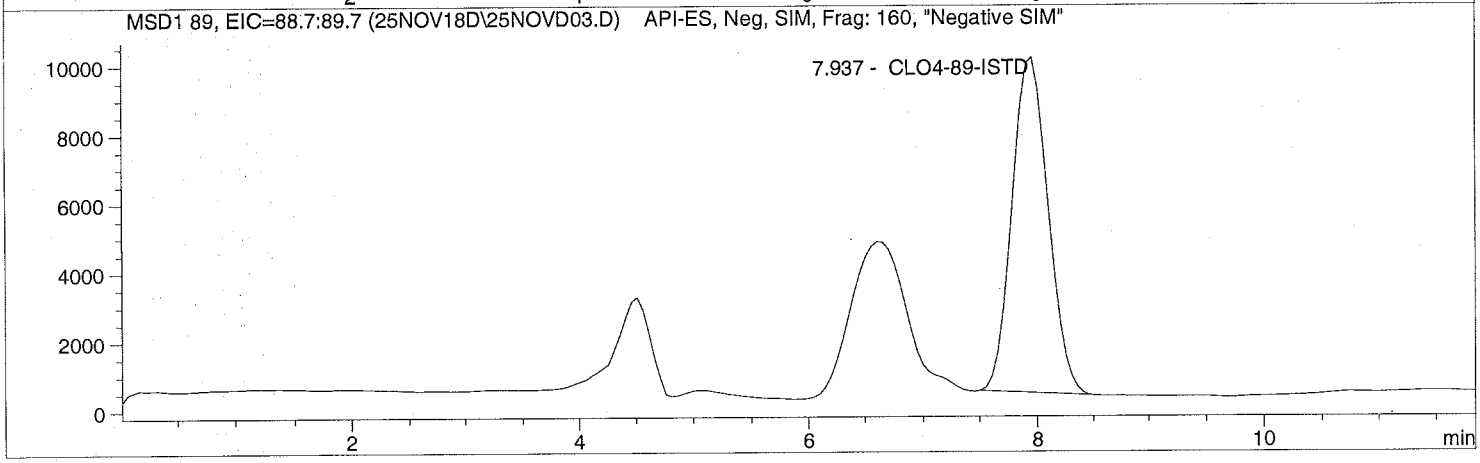
Injection Date:	11/25/2018 12:54:03	Seq Line:	3
Sample Name:	628726 ICS@1.0	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD03.D Sample Name: 628726 ICS@1.0

Injection Date:	11/25/2018 12:54:03	Seq Line:	3
Sample Name:	628726 ICS@1.0	Location:	Vial 73
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	1.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.903	PBA	42154.0	0.8214	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
0.000		0.0	0.0000	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.937	PBA	212410.2	5.0000	CLO4-89-ISTD

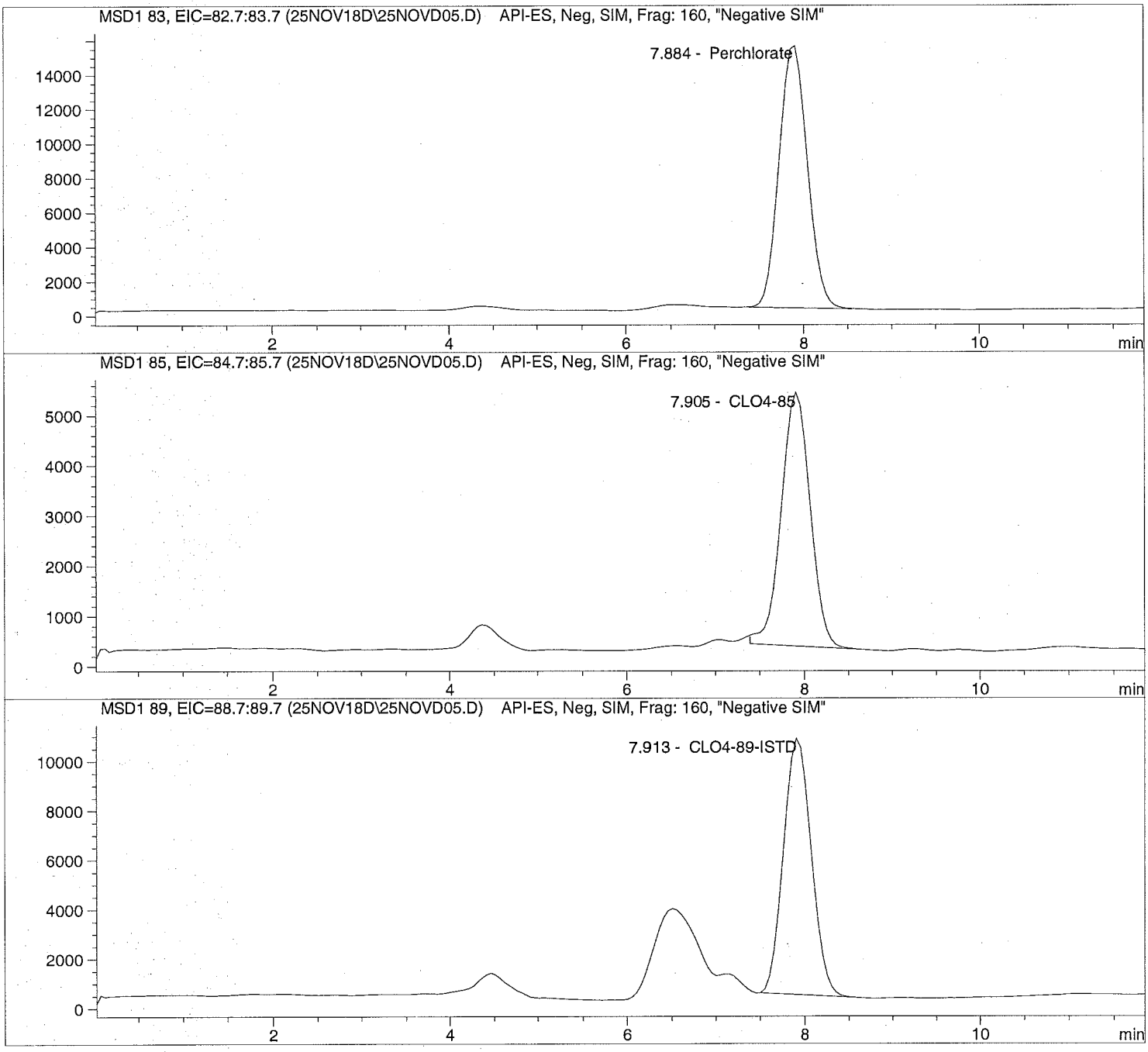
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD05.D Sample Name: 628728 QC@5.0

Injection Date:	11/25/2018 13:21:35	Seq Line:	5
Sample Name:	628728 QC@5.0	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD05.D Sample Name: 628728 QC@5.0

Injection Date:	11/25/2018 13:21:35	Seq Line:	5
Sample Name:	628728 QC@5.0	Location:	Vial 75
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	5.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.884	BBA	335064.7	4.7667	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.905	BBA	113875.7	5.3060	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.913	PBA	225430.6	5.0000	CLO4-89-ISTD

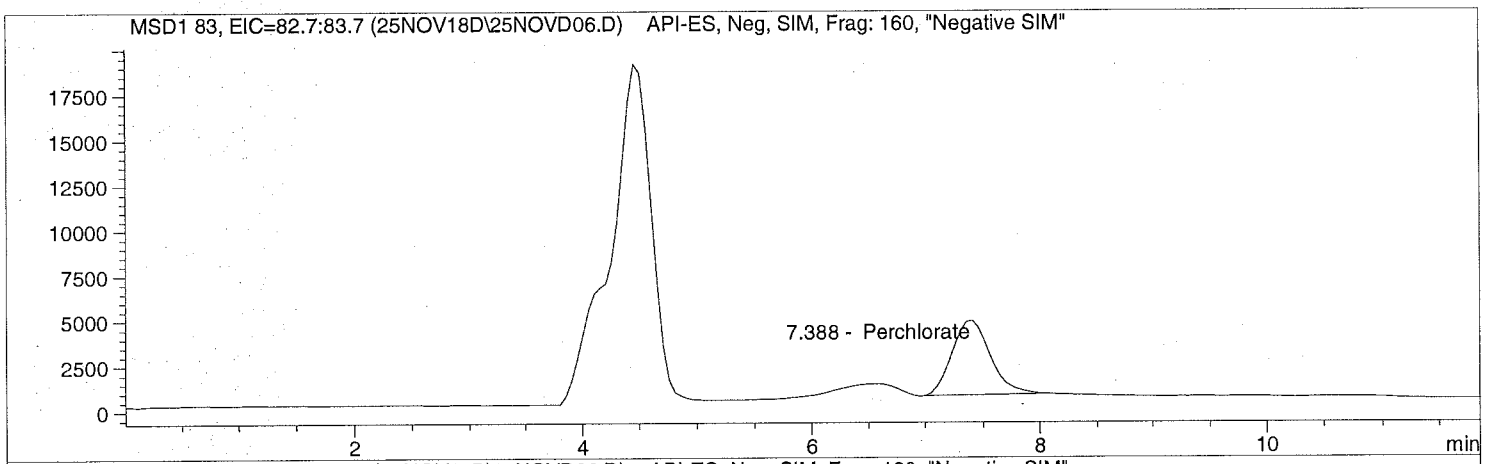
*** End of Report ***

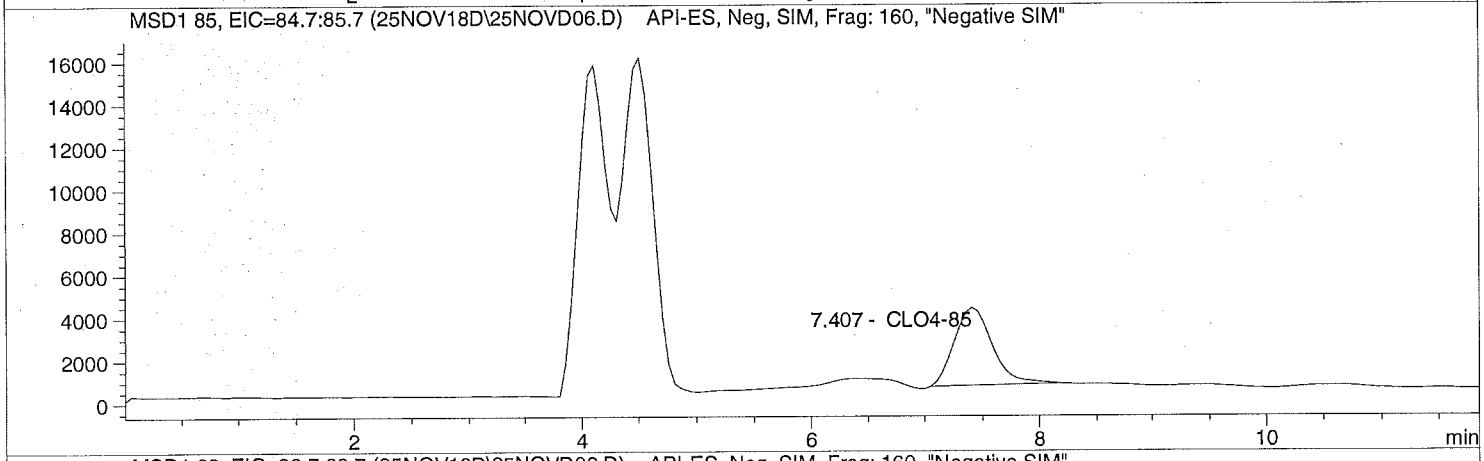
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD06.D Sample Name: 1831619001

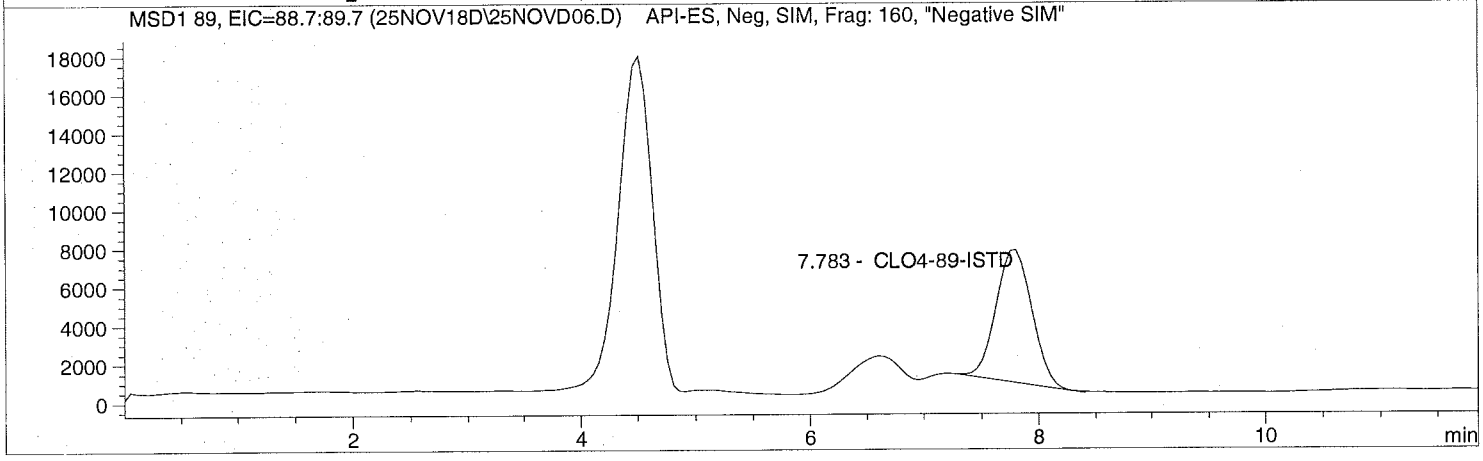
Injection Date:	11/25/2018 13:36:17	Seq Line:	6
Sample Name:	1831619001	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD06.D Sample Name: 1831619001

Injection Date:	11/25/2018 13:36:17	Seq Line:	6
Sample Name:	1831619001	Location:	Vial 76
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.388	PBA	95094.2	2.1605	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.407	PBA	84029.6	5.8631	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.783	BBA	150099.2	5.0000	CLO4-89-ISTD

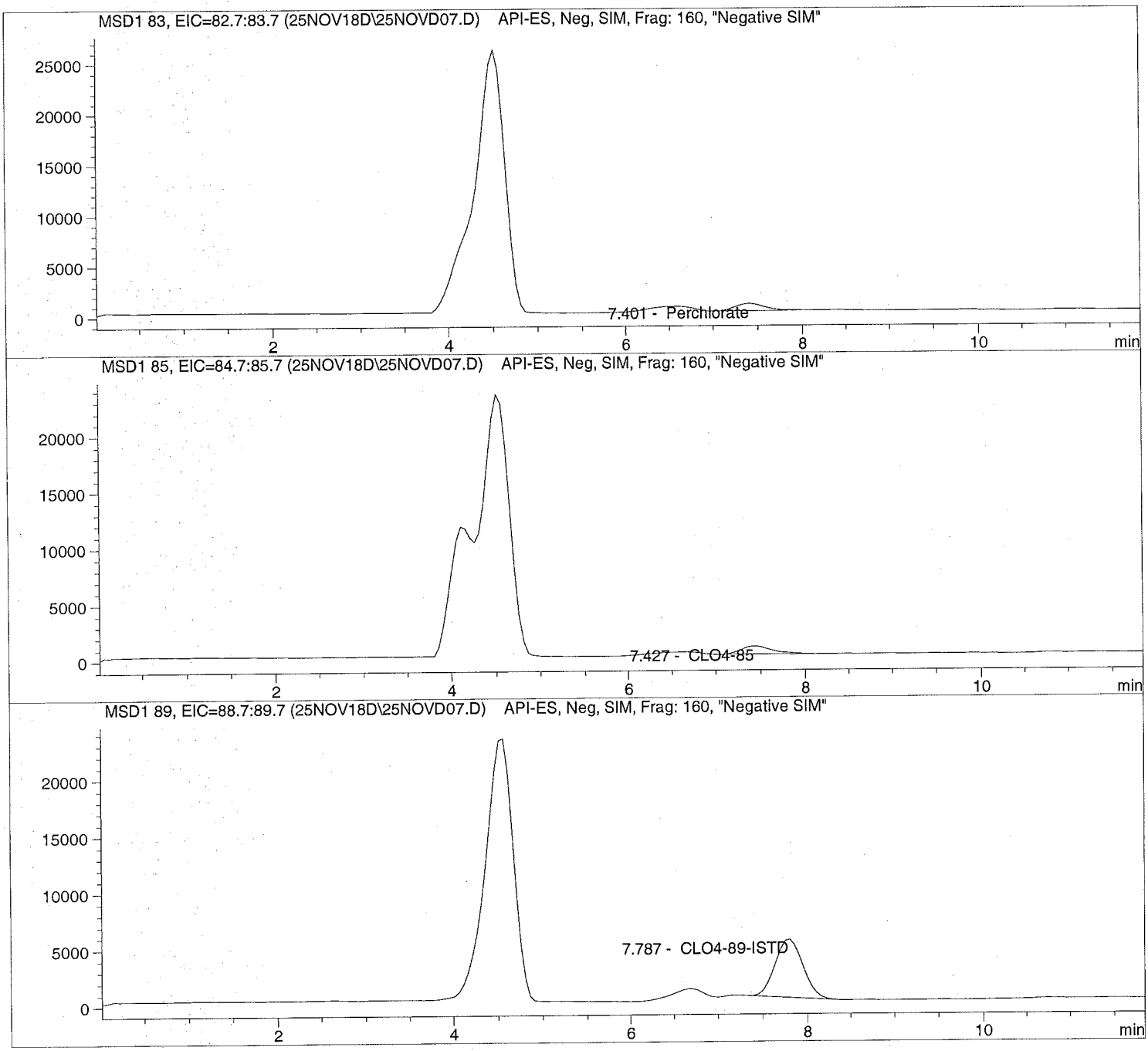
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD07.D Sample Name: 1831619002

Injection Date:	11/25/2018 13:50:04	Seq Line:	7
Sample Name:	1831619002	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD07.D Sample Name: 1831619002

Injection Date:	11/25/2018 13:50:04	Seq Line:	7
Sample Name:	1831619002	Location:	Vial 77
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.401	PBA	16730.4	0.6706	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.427	PBA	17644.2	1.7304	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.787	BBA	111854.5	5.0000	CLO4-89-ISTD

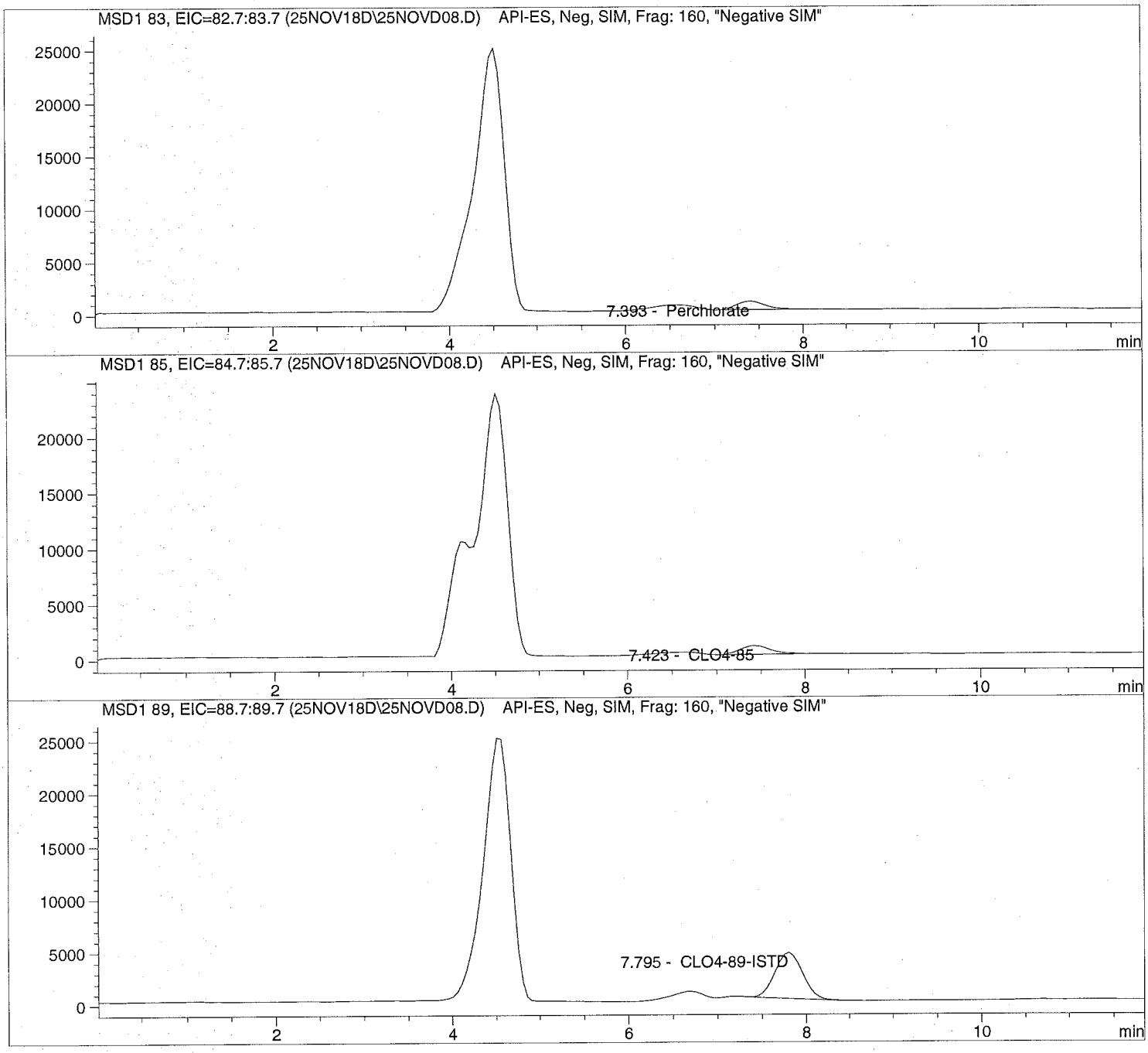
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD08.D Sample Name: 1831619003

Injection Date:	11/25/2018 14:03:48	Seq Line:	8
Sample Name:	1831619003	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD08.D Sample Name: 1831619003

Injection Date:	11/25/2018 14:03:48	Seq Line:	8
Sample Name:	1831619003	Location:	Vial 78
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.393	PBA	17946.2	0.7888	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.423	PBA	18734.2	2.1288	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.795	BBA	95512.3	5.0000	CLO4-89-ISTD

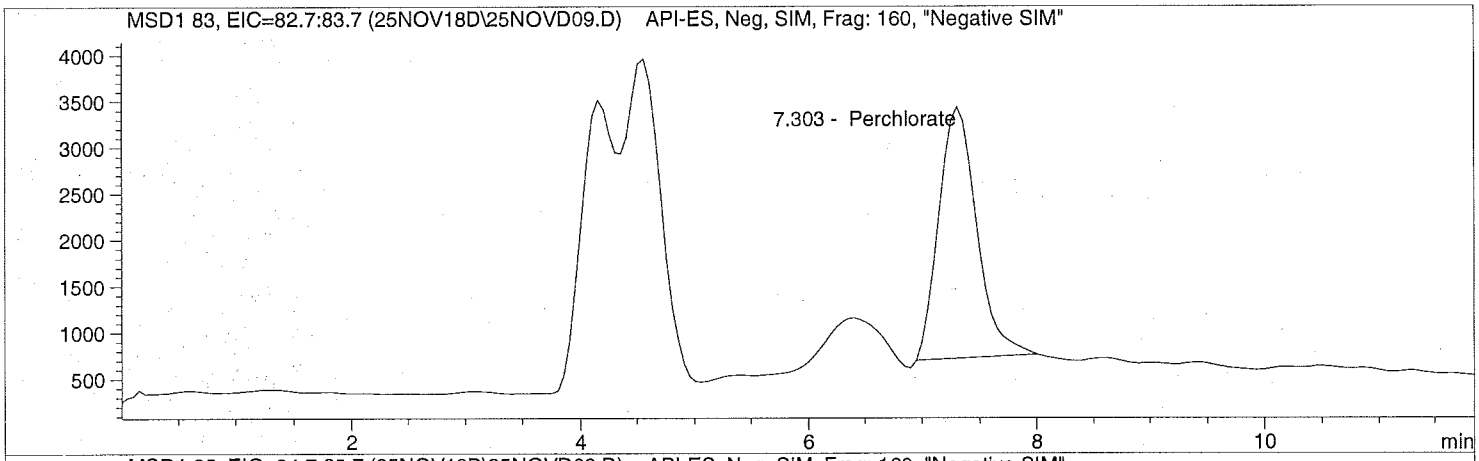
*** End of Report ***

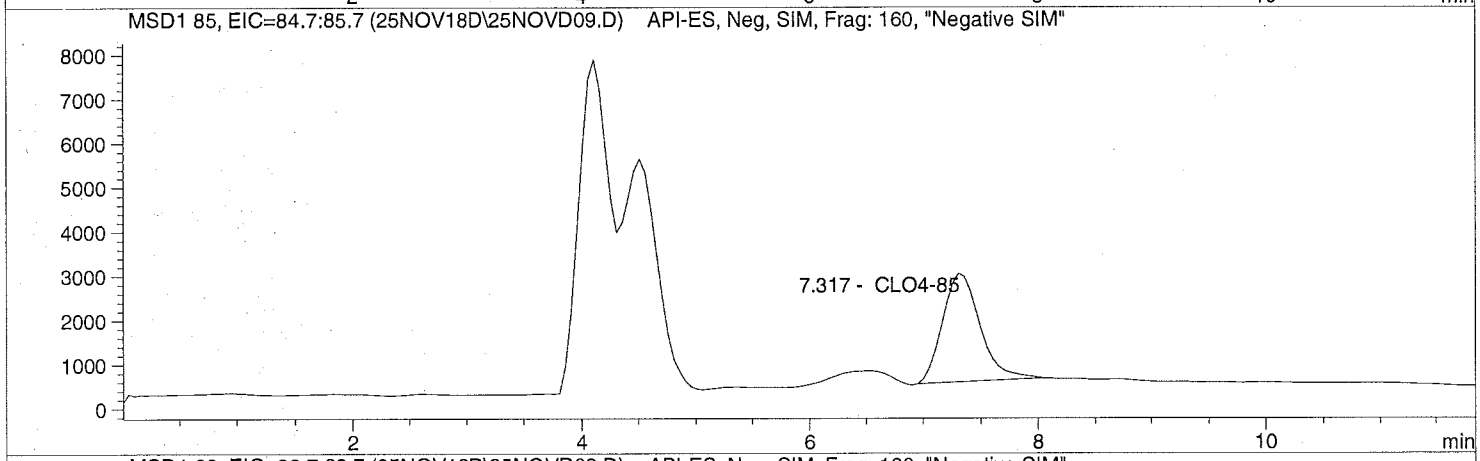
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD09.D Sample Name: 1831619004

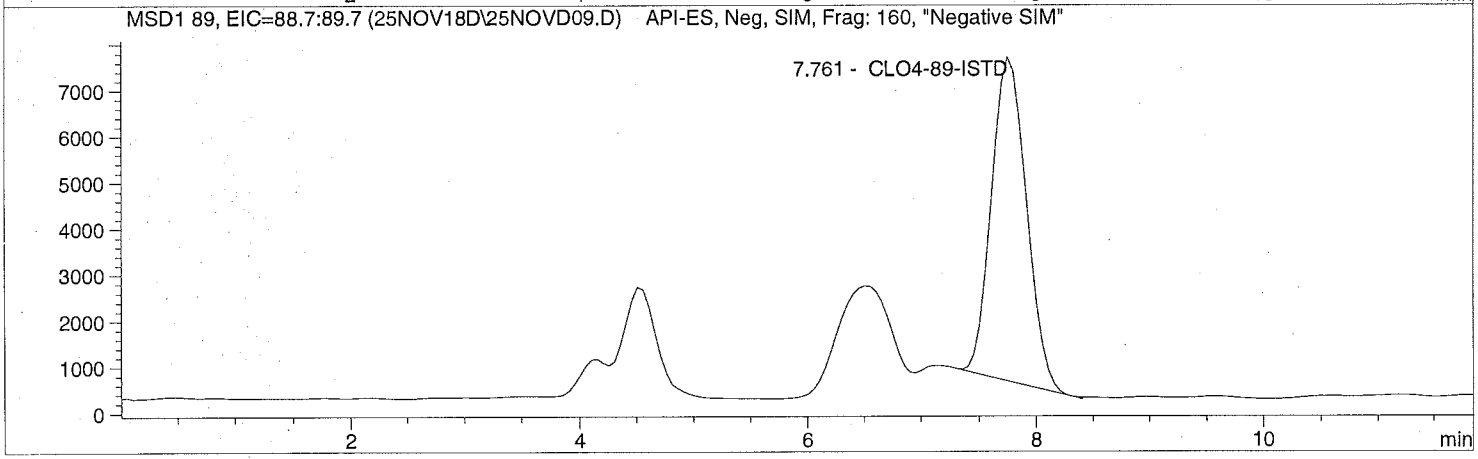
Injection Date:	11/25/2018 14:17:35	Seq Line:	9
Sample Name:	1831619004	Location:	Vial 79
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD09.D Sample Name: 1831619004

Injection Date:	11/25/2018 14:17:35	Seq Line:	9
Sample Name:	1831619004	Location:	Vial 79
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.303	PBA	61630.1	1.4887	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.317	PBA	55293.5	3.9465	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.761	BBA	148506.7	5.0000	CLO4-89-ISTD

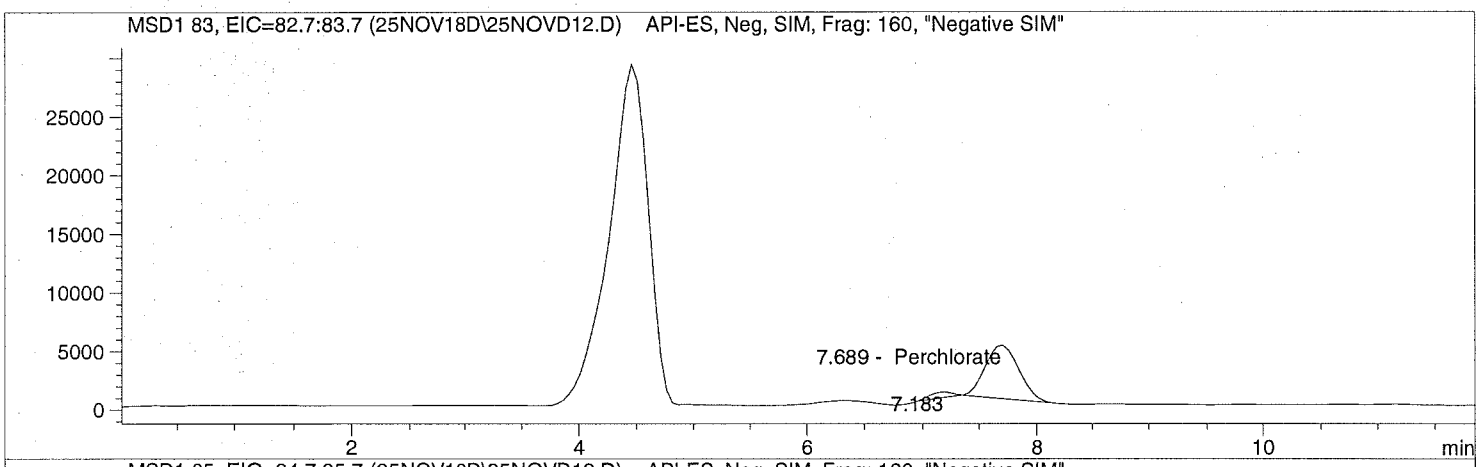
*** End of Report ***

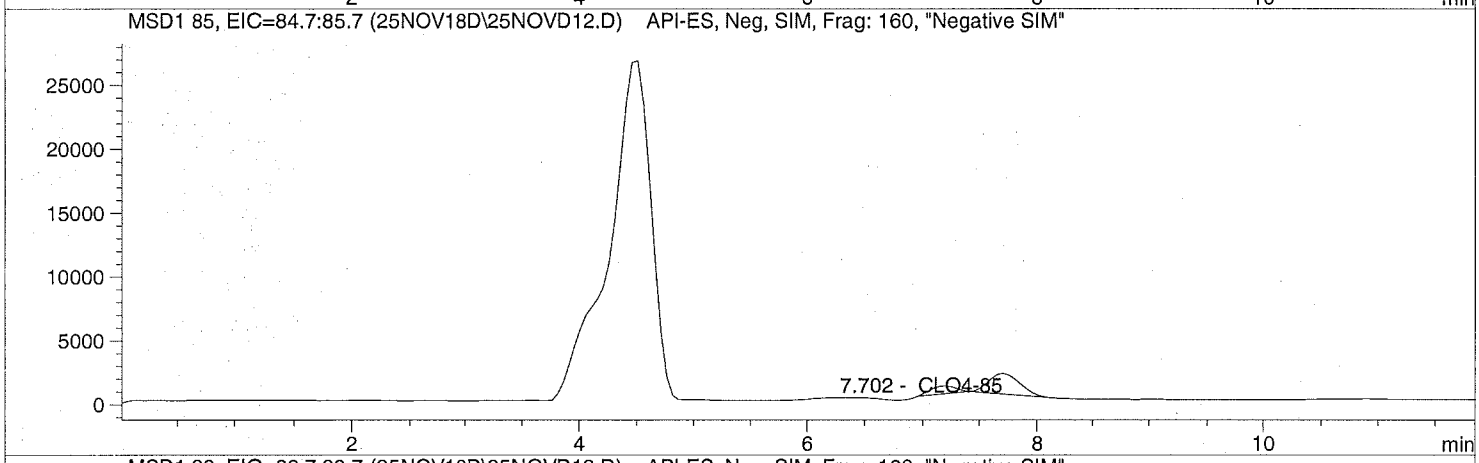
Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD12.D Sample Name: 1831619007 MS

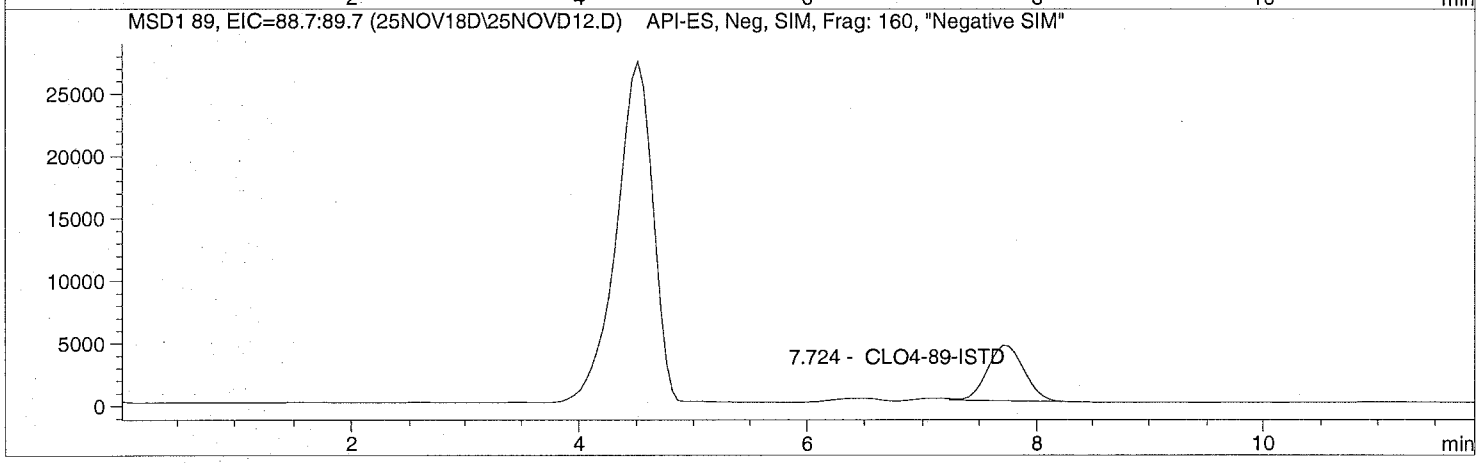
Injection Date:	11/25/2018 14:59:04	Seq Line:	12
Sample Name:	1831619007 MS	Location:	Vial 82
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis







Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD12.D Sample Name: 1831619007 MS

Injection Date:	11/25/2018 14:59:04	Seq Line:	12
Sample Name:	1831619007 MS	Location:	Vial 82
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.183	PB	6741.2	0.0000	
7.689	VBA	92399.6	3.1169	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.193	PB	9895.5	0.0000	
7.702	VBA	30789.4	3.3577	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.724	BBA	97718.7	5.0000	CLO4-89-ISTD

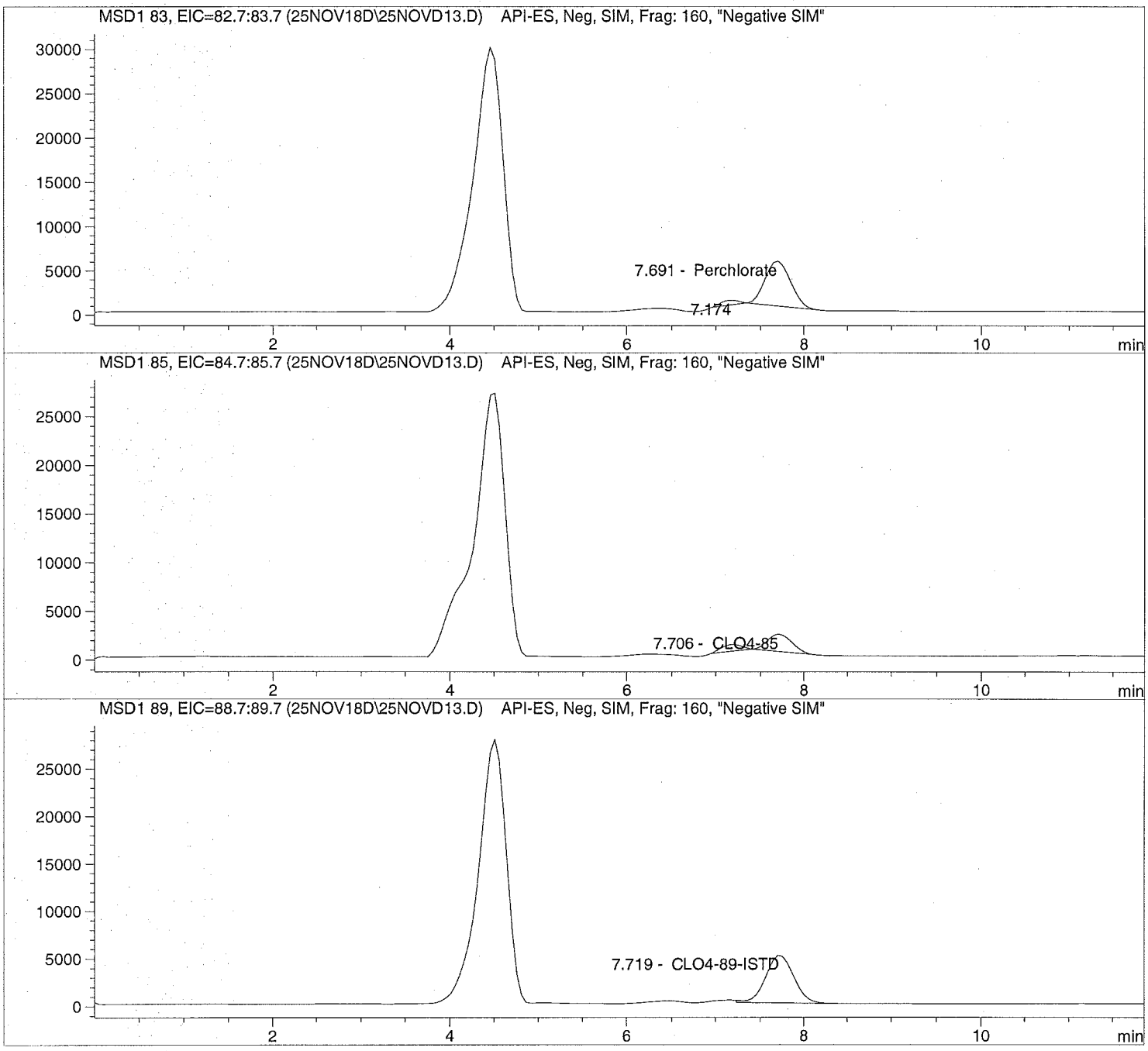
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD13.D Sample Name: 1831619008 MSD

Injection Date:	11/25/2018 15:12:53	Seq Line:	13
Sample Name:	1831619008 MSD	Location:	Vial 83
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD13.D Sample Name: 1831619008 MSD

Injection Date:	11/25/2018 15:12:53	Seq Line:	13
Sample Name:	1831619008 MSD	Location:	Vial 83
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.174	PB	7626.1	0.0000	
7.691	VBA	103925.2	3.0578	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.194	PB	10735.3	0.0000	
7.706	VBA	34726.2	3.3002	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.719	BBA	112199.8	5.0000	CLO4-89-ISTD

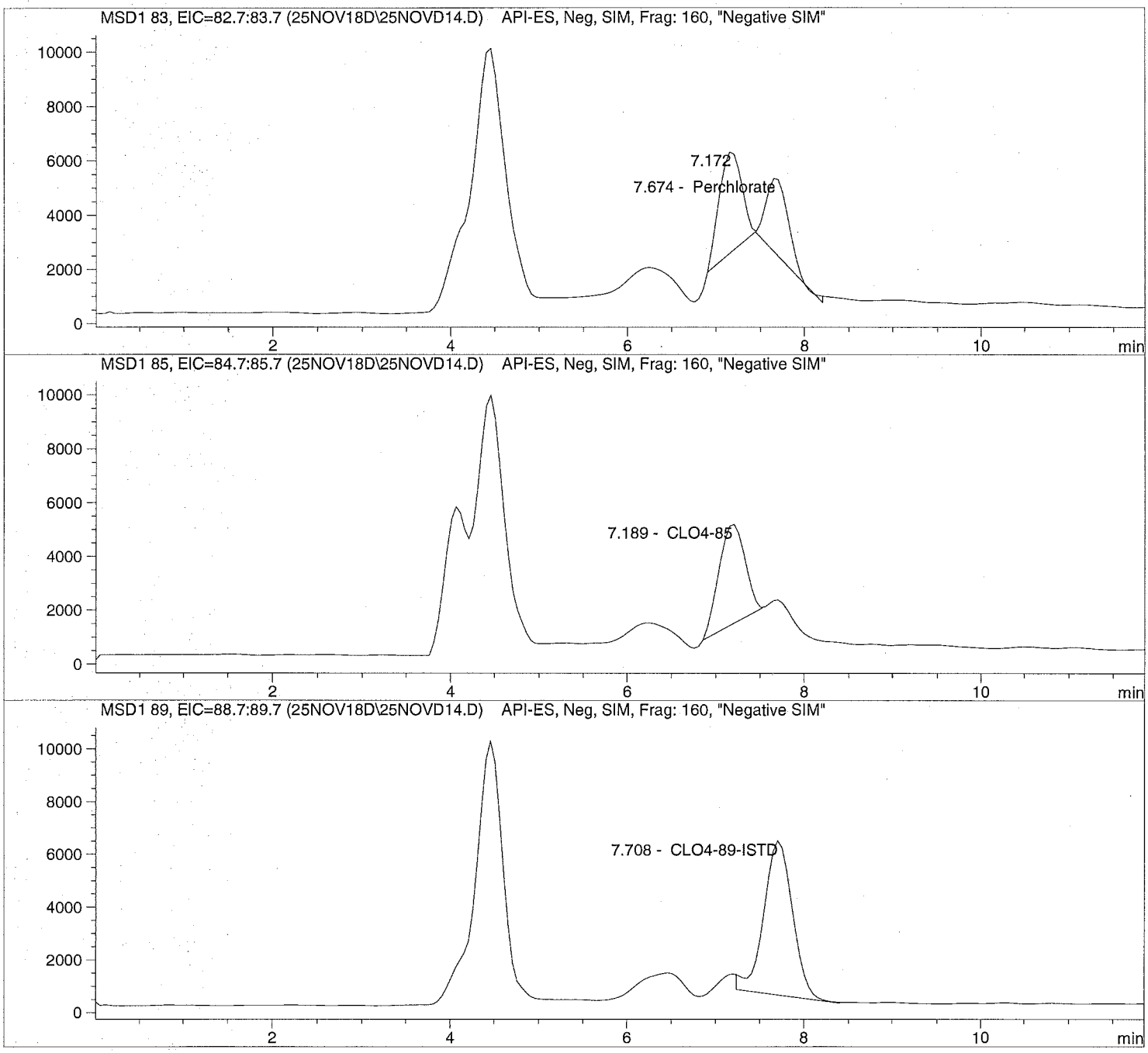
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD14.D Sample Name: 1831619009

Injection Date:	11/25/2018 15:26:38	Seq Line:	14
Sample Name:	1831619009	Location:	Vial 84
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\25NOV18D\25NOVD14.D Sample Name: 1831619009

Injection Date:	11/25/2018 15:26:38	Seq Line:	14
Sample Name:	1831619009	Location:	Vial 84
Acq Operator:	TNB	Inj. No.:	1
		Inj. Vol.:	30 µl

Acq. Method: CLO4-AQN.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 11/25/2018 10:56:52

Perchlorate analysis

Sample Information

Sorted By:	Signal
Calib. Data Modified:	Wed, 21. Nov. 2018,01:02:02 pm
Multiplier:	1.000000
Dilution:	1.000000
Sample Amount:	0.000

LCMS Results

Signal1: MSD1 83, EIC=82.7:83.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.172	PB	64961.8	0.0000	
7.674	VBA	48333.6	1.3321	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.189	PBA	75631.6	5.9645	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
7.708	BBA	132734.4	5.0000	CLO4-89-ISTD

*** End of Report ***

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

April 18, 2019

DAIM-ODB-LO

Mr. Rich Mayer
U.S. Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Draft Explanation of Significant Differences, Record of Decision Dated September 2010, Contingency Remedy at LHAAP-50, Former Sump Water Tank, Longhorn Army Ammunition Plant, Karnack, Texas, February 2019

Dear Mr. Mayer,

Two hard copies and two compact discs (CDs) of the above-referenced document is being transmitted to you for your review. Review comments are requested by May 20, 2019.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) team, on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX (letter)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy and 1 CD)
A. Williams, USACE, Tulsa District, OK (1 CD)
R. Smith, USACE, Tulsa District, OK (electronic only)
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate, Lakewood, CO (1 CD)
P. Srivastav, APTIM, Houston, TX (letter)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

April 18, 2019

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality
Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Draft Explanation of Significant Differences, Record of Decision Dated September 2010, Contingency Remedy at LHAAP-50, Former Sump Water Tank, Longhorn Army Ammunition Plant, Karnack, Texas, February 2019

Dear Ms. Palmie,

One hard copy and one compact disc (CD) of the above-referenced document are being transmitted to you for your review. Review comments are requested by May 20, 2019.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) team, on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX (letter)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy and 1 CD)
A. Williams, USACE, Tulsa District, OK (1 CD)
R. Smith, USACE, Tulsa District, OK (electronic only)
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate, Lakewood, CO (1 CD)
P. Srivastav, APTIM, Houston, TX (letter)

Subject:	**Final Minutes, Monthly Managers' Meeting (MMM), Longhorn Army Ammunition Plant (LHAAP)**
Location of Meeting:	**Via Conference Call-In 267-930-4000 with code 041-819-550**
Date of Meeting:	**12 December 2018 – 1:00 PM Central Standard Time (CST)**

Attendees:

Army BRAC:	Rose Zeiler (RMZ)
EPA:	Rich Mayer (RM)
TCEQ:	April Palmie (AP)
USFWS:	Paul Bruckwicki (PB)
USACE:	Aaron Williams (AW)
Bhate:	Kim Nemmers (KN)
APTIM:	Praveen Srivastav (PS) and Susan Watson (SW)

Action Items
Bhate/APTIM

Variance for Well Installation Changes at LHAAP-16: AW asked AP about the value of a one (1)-inch well. AP stated that the one-inch wells could be used to determine if contamination is present but if identified then a more permanent two (2)-inch or four (4)-inch well would be required. RM agreed with this statement. AW confirmed that there is risk using this approach given that the 1-inch well would need to be replaced if contamination is identified. RMZ stated that she thought the risk was due to the well not potentially producing sufficient water volumes. RMZ asked why a 1-inch well would not be acceptable. AP stated that 2-inch or 4-inch wells are typically used for groundwater monitoring purposes, and that 1-inch wells are not usually permanent (more of a hydropunch type use). RMZ stated that she concurred if long-term monitoring is required, a 2-inch or 4-inch well will be necessary. AP stated that current conditions are not known but that if contamination is found then additional monitoring points would be necessary to delineate the contamination.

PS stated that APTIM is leaning towards installing 2-inch monitoring wells in mid-January. PS stated that he understands that installing rock is not acceptable. However, installing mats is a temporary solution because the mats would need to be removed. RMZ stated that the All-Terrain Vehicle (ATV) could be used to access the area after the drilling effort. AP stated that those wells may not need to be sampled at the same time as the other wells if the area is wet and that is understood. PS stated that he is working with the driller on ways to access the area via the low point. PS asked PB if something closer to soil could be used if rock was not acceptable. PB stated that the USFWS wants the minimal impacts to the area. PB stated that a study by the duck pond was being completed using anodes to draw the water out via a study for the Department of Defense. PS stated that the drillers don't have mats so APTIM is looking into the option further. KN stated that an email is still required to document the variance from a 4-inch well to a 2-inch well. AP and RM concurred that the email is acceptable as long as the Remedial Action documents the change also.

Monitored Natural Attenuation (MNA) Parameters Technical Memorandum: PS stated that the Army should receive the document for review shortly and the Regulators will receive the document in January. AW asked if this information was to be presented in each of the individual site reports. KN stated that the technical memorandum was to summarize the optimization of MNA parameters and then be referenced in each site report.

Defense Environmental Restoration Program (DERP) Performance Based Remediation (PBR) Update

KN asked everyone to refer to the Document and Issues Tracking Table dated 20 December 2018.

- **Task 1** (Project Management) -
  - KN stated that the email from RM was received that there were no edits to the December 2018 MMM Minutes. KN stated that she would issue the edits from AP in track changes for review and approval.
  - KN pointed out that the Restoration Advisory Board (RAB) Meeting was planned to be moved to the last Thursday in January 2019. RM stated that was okay. AP asked if everything was moving (e.g Proposed Plan [PP] public meeting and RAB) to which AW concurred.
- **Task 3** (LHAAP-03) –. Soil sampling was completed on November 29 and the results are coming in. PS stated that the Remedial Design (RD)/Remedial Action Work Plan (RAWP) is due in June 2019.
- **Task 4** (LHAAP-04 Technical Memorandum for Plume Delineation) –PS stated that the RD/RAWP was prepared for the Army when the work was paused for the additional investigation that is ongoing. PS stated that direct push technology (DPT) points were completed the week of December 3, 2018. The next four DPT points are being installed this week. Per PS, data is expected on December 17, 2018 from the advancement of these four DPT points. RMZ stated that she was expecting the call for concurrence on well locations on Tuesday afternoon. RM stated that he could join the call on Tuesday afternoon. PS stated that Tuesday afternoon would work unless something changes.
- **Task 5** (LHAAP-12 Annual Remedial Action – Operation [RA-O] Report) – PS stated that the 2018 sampling is being completed in December 2018 and will be provided in February 2019. Also, the RA-O report for the 2018 sampling will be provided in April 2019.
- **Task 6** (LHAAP-16) – PS stated that no documents are in progress.
- **Task 7** (LHAAP-17) - PS stated that the draft RD/RAWP is internal review and will be ahead of schedule with the date of submittal to regulators likely to be before December 28, 2018.
- **Task 9** (LHAAP-37) – PS stated that the Year 2, Quarter 1 sampling was completed in the last week in November 2018. Validated data from that sampling event should be presented at the January 2019 MMM. The Year 1 RA-O Report should also be available for draft submittal in January.
- **Task 10** (LHAAP-46) Year 4 RA-O Report –PS stated that the Year 4 Annual RA-O Report is currently in internal review with the Army and will be submitted in January 2019.
- **Task 11** (LHAAP-50) –. The Draft Final Year 4 RA-O Report was submitted on December 5, 2018. AP questioned whether an email was provided. SW stated that she would look in her outbox. Year 5 RA-O sampling was also done in November 2018 and will be available in January 2019. PS stated that the Explanation of Significant Difference (ESD) for in situ bioremediation is in internal review with the Army. A draft of the ESD is expected to be available in February 2019.
- **Task 12** (LHAAP-58) – KN stated that the entire LHAAP-58 (both eastern and western lobes) was currently being sampled and the goal is to have this data available for the meeting for the January 2019 MMM.
- **Task 13** (LHAAP-67) – PS stated that comments from the EPA and TCEQ on the Draft Year 4 RA-O Report were received and the Draft Final document will be released on or ahead of the 19 December 2018 deadline. PS stated that Year 5 sampling was completed in

the last week in October 2018, and the data package is included in the validated data package provided by KN.

- **Task 14** (LHAAP-001-R-001) - KN stated that Site LHAAP-001-R-01 data is provided in the validated data package for the meeting. The detected perchlorate was less than 17 parts per billion so the sampling is complete under the Record of Decision (ROD) for the site.
- **Task 16** (Groundwater Treatment Plant [GWTP]) **–** KN stated that the 3rd Quarter 2018 GWTP Report is due in December 2018 but asked if the report should be moved for a due date in January 2019. AW stated that the document can move to January 2019.
- **Task 17** (LHAAP-18/24) – KN stated that the site wells are being sampled after LHAAP-58 in December 2018. KN stated that monitoring well 18WW10 will be sampled in place of 123. KN stated that the validated data will be provided with the February 2019 MMM information.
- **Task 18** (Surface Water) - KN stated that the Year 1 technical memorandum with the 2018 surface water results will be sent out for informational purposes only. AW reminded KN that the document also needs to be placed in the administrative Record (AR).
- **Administrative Record –** PS stated that the update through August 31, 2018 is in progress. SW realized that the compact disc had not been sent out, which needed to be completed.

Update on other DERP Sites

- **LHAAP 18/24** – AW explained that the response to Regulatory comments on the Draft PP for LHAAP-18/24 were being prepared and would be submitted by 19 December 2018 back to the TCEQ and EPA.
- **LHAAP-29** – AW stated the public meeting for the PP was held. HDR is in the process of drafting the Site 29 ROD, which is currently due to the Regulators as draft on 30 May 2019.
- **LHAAP-47** –AW stated that the field work is complete aside from the surface water sampling. The Post-Screening Investigation (PSI) Report is being prepared for submittal to the Regulators in January 2019.
- **Five- Year Review (FYR)** – RMZ stated that the FYR is still expected to be released in December 2018 to the EPA and TCEQ but that there have been some schedule challenges and it might run into January. RM and AP indicated that would be okay.

GWTP

KN stated that the GWTP is up and running and that the new ion exchange vessels are installed. KN stated that treated effluent from the GWTP is being discharged to the Harrison Bayou and a sample was collected at the end of November 2018 after the system was put back online. KN stated that potable water is still not available. KN stated that the camera was installed at the creek but it needs to be adjusted once the water level in the bayou recedes to be better able to read the staff gauge.

Schedule Next Managers' Meeting

The next MMM will be held on 31 January 2019 at 10:30 am CST at the LHAAP trailer. KN confirmed that the RAB will be held from 5pm to 6pm with the LHAAP-18/24 PP public meeting to follow from 6pm to 7:30pm on 31 January 2019.

ACRONYM LIST

AP	April Palmie
APTIM	APTIM Federal Services, LLC
AR	Administrative Record
ATV	All Terrain Vehicle
AW	Aaron Williams
Bhate	Bhate Environmental Associates, Inc.
BRAC	Base Realignment and Closure
CST	Central Standard Time
DERP	Defense Environmental Restoration Program
DPT	Direct Push Technology
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
GWTP	Ground Water Treatment Plant
KN	Kim Nemmers
LHAAP	Longhorn Army Ammunition Plant
MMM	Monthly Managers' Meeting
MNA	Monitored Natural Attenuations
PBR	Performance-Based Remediation
PP	Proposed Plan
PS	Praveen Srivastav
PSI	Post-Screening Investigation
RACR	Remedial Action Completion Report
RAB	Restoration Advisory Board
RA-O	remedial action – operation
RAWP	Remedial Action Work Plan
RD	Remedial Design
Rob M	Robert Mayer
ROD	Record of Decision
RM	Rich Mayer
RMZ	Rose M. Zeiler
SW	Susan Watson
TCEQ	Texas Commission on Environmental Quality
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

LHAAP Data Validated
December 2018 MMM

LHAAP Surface Water	*Quarterly Perchlorate Sampling - October 2018* Perchlorate (6850)
LHAAP Site 001-R-01	*Annual Perchlorate Sampling – November 2018* Perchlorate (6850)
LHAAP-67	*Semiannual MNA Groundwater Sampling, Year 5, October 2018* VOC (SW8260)

LHAAP-Quarterly Surface Water Sampling - October 2018

Location ID: / Sample Date:	Units	PCL	HBW7_101718 10/17/18	HBW10_101718 10/17/18	HBW1_101718 10/17/18	GPW1_101718 10/17/18	GPW3_101718 10/17/18
Perchlorate (6850)			Harrison Bayou			Goose Prairie Creek	
Perchlorate	µg/L	17	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U

PCL – Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level

µg/L - micrograms per liter

U - Undetected: The analyte was analyzed for, but not detected.

LHAAP-001 November 2018

Location ID: / Sample Date:	Units	TRRP PCL	27WW01_110718 11/7/18	27WW02_110718 11/7/18	27WW03_110618 11/6/18	27WW04_110618 11/6/18	27WW04_110618a 11/6/18	131_110618 11/6/18	132_110618 11/6/18
			NW, inside site boundary.	NW, inside site boundary.	W, inside OB/OD area.	NW, inside site boundary.	NW, inside site boundary. Field duplicate.	N, inside OB/OD area.	S, inside OB/OD area.
Perchlorate (6850)									
Perchlorate	µg/L	17	< 2.0 UJ	**2.5 J**	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U

µg/L - micrograms per liter

TRRP PCL - Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Limit

U- Undetected: The analyte was analyzed for, but not detected

J - estimated result between the detection limit and limit of quantitation

UJ - Estimated non-detect due to discrepancies in meeting certain analyte-specific quality control criteria

LHAAP-67 Semiannual MNA Groundwater Sampling, Year 5 - October 2018

	Location Code		67WW02		67WW05		67WW05		67WW07		67WW08		67WW08		67WW09		67WW09A	
	Sample ID		67WW02-181025		67WW05-181025		67WW05-181025-FD		67WW07-181025		67WW08-181023		67WW08-181023-FD		67WW09-181023		67WW09A-181025	
	Sample Date		10/25/2018		10/25/2018		10/25/2018		10/25/2018		10/23/2018		10/23/2018		10/23/2018		10/25/2018	
	Location Description		Site 67 - NW, within site boundary.		Site 67 - WNW, outside site boundary.		Site 67 - WNW, outside site boundary.		Site 67 - E, outside site boundary.		Site 67-S, within site boundary.		Site 67-S, within site boundary.		Site 67-S outside site boundary.		Site 67 - S outside site boundary.	
Parameter	Units	MCL/GW-IND	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
VOC																		
1,1,1-Trichloroethane	µg/L	200	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
1,1,2-Trichloroethane	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
1,1-Dichloroethene	µg/L	7	6.9		< 0.5	U	< 0.5	U	< 0.5	U	160		160		< 0.5	U	< 0.5	U
1,2-Dichloroethane	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	6.5		6.2		< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Trichloroethene	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Vinyl chloride	µg/L	2	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue Highlighting Indicates concentrations above the MCL/PCL.

Some samples may have been diluted due to the concentration(s) of one or more analytes exceeding the upper limit of the calibration curve.

µg/L - micrograms per liter

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

GW-Ind -

mg/L - milligrams per liter

MCL - Maximum Contaminant Limit

U - Undetected: The analyte was analyzed for, but not detected.

VOC - volatile organic compound

LHAAP-67 Semiannual MNA Groundwater Sampling, Year 5 - October 2018

	Location Code		67WW10		67WW11		67WW12		67WW13		67WW14		67WW15		67WW16I	
	Sample ID		67WW10-181022		67WW11-181023		67WW12-181022		67WW13-181023		67WW14-181022		67WW15-181023		67WW16I-181025	
	Sample Date		10/22/2018		10/23/2018		10/22/2018		10/23/2018		10/22/2018		10/23/2018		10/25/2018	
	Location Description		Site 67 - SE, outside site boundary.		Site 67- SW, outside site boundary.		Site 67 - NE, within site boundary.		Site 67 - NE, within site boundary.		Site 67 - SW, outside the site boundary beside		67-W, outside site boundary.		67 - S, within site boundary.	
Parameter	Units	MCL/GW-IND	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
VOC																
1,1,1-Trichloroethane	µg/L	200	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
1,1,2-Trichloroethane	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	6.1		< 0.5	U	6		< 0.5	U
1,1-Dichloroethene	µg/L	7	< 0.5	U	6.1		4.8		570		6.6		670		< 0.5	U
1,2-Dichloroethane	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	43		2.5		30		< 0.5	U
cis-1,2-Dichloroethene	µg/L	70	< 0.5	U	< 0.5	U	< 0.5	U	1.9		< 0.5	U	1.7		< 0.5	U
Trichloroethene	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	2.4		< 0.5	U	1.4		< 0.5	U
Vinyl chloride	µg/L	2	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue Highlighting Indicates concentrations above the MCL/PCL.

Some samples may have been diluted due to the concentration(s) of one or more analytes exceeding the upper limit of the calibration curve.

µg/L - micrograms per liter

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

GW-Ind -

mg/L - milligrams per liter

MCL - Maximum Contaminant Limit

U - Undetected: The analyte was analyzed for, but not detected.

VOC - volatile organic compound

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 20, 2019

DAIM-ODB-LO

Mr. Rich Mayer
U.S. Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Draft Remedial Design/Remedial Action Work Plan, LHAAP-04 Former Pilot Wastewater Treatment Plant, Longhorn Army Ammunition Plant, Karnack, Texas, February 2019

Dear Mr. Mayer,

One hard copy and one compact disc (CD) of the above-referenced document is being transmitted to you for your review. Review comments are requested by March 25, 2019.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) team, on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX (letter)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy and 1 CD)
A. Williams, USACE, Tulsa District, OK (1 CD)
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate, Lakewood, CO (1 CD)
P. Srivastav, APTIM, Houston, TX (letter)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 20, 2019

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality
Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Draft Remedial Design/Remedial Action Work Plan, LHAAP-04 Former Pilot Wastewater Treatment Plant, Longhorn Army Ammunition Plant, Karnack, Texas, February 2019

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DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 26, 2019

DAIM-ODB-LO

Mr. Rich Mayer
U.S. Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Final Technical Memorandum – Monitored Natural Attenuation Monitoring Parameters, Longhorn Army Ammunition Plant, Karnack, Texas, February 2019

Dear Mr. Mayer,

One hard copy and one compact disc (CD) of the above-referenced document is being transmitted to you for your records. Comments, not requiring revisions, were received on the Draft version of the document from Environmental Protection Agency (EPA) and from Texas Commission on Environmental Quality (TCEQ) on February 15, 2019.

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Final
Technical Memorandum – Monitored Natural Attenuation Monitoring Parameters
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared for U.S. Army Corps of Engineers, Tulsa District
Contracting Division
2488 East 81st Street
Tulsa, Oklahoma 74137-4290

Prepared by

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APTIM

Aptim Federal Services, LLC
2500 CityWest, Suite 1700
Houston, Texas 77042

Contract No. W9128F-13-D-0012
Task Order No. W9128BV17F0150
Project No. 501032
Rev 0
February 2019

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Acronyms and Abbreviations

APTIM	Aptim Federal Services, LLC
LHAAP	Longhorn Army Ammunition Plant
LUC	land use controls
MNA	monitored natural attenuation
RACR	Remedial Action Completion Report
RA-O	Remedial Action Operation
RAWP	Remedial Action Work Plan
TCE	trichloroethene

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Contract No. W9128F-13-D-0012, Task Order No. W9128BV17F0150 • Final • Rev 0 • February 2019

1.0 INTRODUCTION

The purpose of this Technical Memorandum is to create a standard list of monitored natural attenuation (MNA) parameters across Longhorn Army Ammunition Plant (LHAAP) sites and eliminate analysis that are either redundant or not useful for the evaluation of MNA effectiveness. MNA with land use controls (LUCs) is the selected remedy to remediate trichloroethene (TCE) plumes in the groundwater at sites LHAAP-37, LHAAP-67, LHAAP-50, LHAAP-46, and LHAAP-58. On **Table 1**, each site and the three documents, Remedial Action Work Plan (RAWP), Remedial Action Completion Report (RACR), and Remedial Action Operation (RA-O), are listed and cross-referenced with the MNA parameters cited in each document.

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2.0 CURRENT REMEDIAL ACTION OPERATION (RA-O) MONITORING

Currently the list of MNA analytical parameters inclusive of all the sites includes anions (sulfate, sulfide, nitrate, nitrite, and chloride), methane, ethane, ethene, carbon dioxide, total iron, dissolved iron (ferrous) conducted in the lab and in the field, dissolved manganese, total phosphorus, alkalinity, total organic and inorganic carbon as shown on **Table 1**. Some of these analyses are redundant or are not required for the evaluation of MNA at LHAAP sites.

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3.0 PROPOSED PATH FORWARD

The proposed path is to optimize the MNA analytical list so that it is consistent across all sites. The optimization of analytical list will make the sampling and evaluation more accurate and efficient. The optimization includes eliminating MNA parameters that are redundant or nonessential, including alkalinity, nitrite, sulfide, total inorganic carbon, total iron, the lab analysis for dissolved iron and dissolved manganese, and total phosphorous.

Rationale for eliminating these parameters is as follows:

- Alkalinity is used as an indicator of microbial growth, because it is affected by microbial respiration off gases like carbon dioxide. Since alkalinity is affected by carbon dioxide, which is currently being analyzed, it is recommended that alkalinity be removed from the analytical list.
- Nitrate and sulfate concentrations at LHAAP sites are below levels that may inhibit reductive dechlorination, and therefore the reduced states of these chemicals, nitrite and sulfide, are not expected to be observed, and are recommended to be removed from the analytical list. Nitrate and sulfate will remain on analytical list to evaluate increased levels that may inhibit biological reactions in the future.
- Total organic carbon is essential for the MNA analysis; however, total inorganic carbon does not provide useful data and is recommended to be removed from the analytical list.
- The analysis for ferrous iron is being conducted in the field during sample collection and provides the most representative data to determine if iron reducing conditions are present in the groundwater. Total iron analysis for groundwater includes both solid (ferric) and dissolved (ferrous) forms of iron and does not provide useful data in the evaluation of MNA. Therefore, it is recommended that the lab analysis for total iron, and dissolved iron be removed from the analytical list. The field analysis for ferrous iron will remain on the on the analytical list.
- Dissolved manganese is also used to evaluate the reduced state in groundwater, like dissolved iron. The dissolved manganese analysis is redundant, because field analysis for dissolved iron is being retained, and recommended be removed from the analytical list.
- Total phosphorus does not provide essential data the analysis of MNA and is recommended for removal from the analytical list.

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The proposed list of analysis which are consistent across each site include nitrate, sulfate, chloride, methane, ethane, ethene, carbon dioxide, total organic carbon, and field analyzed ferrous iron and is provided on **Table 2**.

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4.0 CONCLUSION

Currently, each of the sites where MNA and LUC are the selected remedy, there is a different list and some of the analyses are redundant or not useful. It is recommended that the following analyses are removed from the MNA parameter list for all sites: alkalinity, nitrite, sulfide, total inorganic carbon, total iron, lab analyzed ferrous iron, dissolved manganese, and total phosphorus. The updated list includes nitrate, sulfate, chloride, methane, ethane, ethene, carbon dioxide, total organic carbon, and field analyzed ferrous iron. The recommended list of parameters will remove redundancy and create more consistent evaluations of the MNA processes in the future.

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Tables

Table 1
MNA Parameter and LHAAP Site Comparison

	LHAAP-37			LHAAP-67			LHAAP-50			LHAAP-46			LHAAP-58		
MNA Parameter	RAWP	RACR	RA-O	RAWP	RACR	RA-O	RAWP	RACR	RA-O	RAWP	RACR	RA-O	RAWP	RACR	RA-O
Alkalinity							x	x	x	x	x	x	x	x	x
Nitrate	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Nitrite		x		x	x	x	x	x	x	x	x	x	x	x	x
Sulfate	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Sulfide		x				x	x	x	x	x	x	x	x	x	x
Chloride	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Methane	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Ethane	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Ethene	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Carbon Dioxide						x	x	x	x	x	x	x	x	x	x
Total Organic Carbon	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Total Inorganic Carbon	x	x		x	x	x									
Iron (dissolved) -field	x	x		x	x	x									x
Iron (dissolved) -lab							x	x	x	x	x	x	x	x	x
Total Iron							x	x	x	x	x	x	x	x	x
Manganese (dissolved)							x	x	x	x	x	x	x	x	x
Total Iron							x	x	x	x	x	x	x	x	x
Total Phosphorous							x	x	x	x	x	x	x	x	x

Notes:

LHAAP-37 RA-O does not list MNA parameters because the Y1Q1 report has not been finalized.

LHAAP - Longhorn Army Ammunition Plant

MNA - monitored natural attenuation

RAWP - Remedial Action Work Plan

RACR - Remedial Action Completion Report

RA-O - Remedial Action Operation

Table 2
Proposed LHAAP MNA Parameters

MNA Parameter	LHAAP-37	LHAAP-67	LHAAP-50	LHAAP-46	LHAAP-58
Nitrate	X	X	X	X	X
Sulfate	X	X	X	X	X
Chloride	X	X	X	X	X
Methane	X	X	X	X	X
Ethane	X	X	X	X	X
Ethene	X	X	X	X	X
Carbon Dioxide	X	X	X	X	X
Total Organic Carbon	X	X	X	X	X
Iron (dissolved) -field	X	X	X	X	X

Notes:

MNA - monitored natural attenuation

LHAAP - Longhorn Army Ammunition Plant

FINAL
PROPOSED PLAN
FOR LHAAP-18/24
BURNING GROUND NO. 3 AND
UNLINED EVAPORATION POND

ISSUED BY: U.S. ARMY

Longhorn Army Ammunition Plant
Karnack, Texas

February 2019

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INTRODUCTION

This Proposed Plan identifies the Preferred Alternative for cleaning up the contaminated soil and groundwater at Longhorn Army Ammunition Plant (LHAAP)-18/24; the site of Burning Ground No. 3 (LHAAP-18) and the Unlined Evaporation Pond (LHAAP-24). The primary purpose of the Proposed Plan is to facilitate public involvement in the remedy selection process. The Proposed Plan provides the public with basic background information about LHAAP-18/24, identifies the preferred final remedy (page 22) to remediate soil and groundwater contamination at the site, explains the rationale for the preference, and describes other remedial options considered. The preferred alternative for LHAAP-18/24 is Alternative 5: enhanced groundwater extraction and treatment, Land Use Controls (LUCs), enhanced in-situ bioremediation (EISB) inside and outside of the containment area in the shallow zone and in the Wilcox Formation, unsaturated soil excavation and off-site disposal, and thermal dense non-aqueous phase liquid (DNAPL) removal.

The U.S. Army is issuing this Proposed Plan for public review, comment, and participation to fulfill part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. §9601 et seq.) and under Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP)(40CFR Part 300). CERCLA prescribes a step-wise progression of activities to respond to risk posed by contaminated sites (**Figure 1**).

Dates to remember: April 2 to May 2, 2019
MARK YOUR CALENDER

PUBLIC COMMENT PERIOD:
April 2 to May 2, 2019
The U.S. Army will accept written comments on the Proposed Plan during the public comment period.

PUBLIC MEETING: The U.S. Army will hold a public meeting to explain the Proposed Plan for LHAAP-18/24. Oral and written comments will be accepted at the meeting. The meeting will be held on April 25, 2019 from 6:00 p.m. to 7:30 p.m. at Karnack Community Center.

For more information, see the Longhorn AAP website: http://www.longhornaap.com/ or visit the Administrative Record at the following location:

Marshall Public Library
300 S. Alamo
Marshall, Texas 75670

Business Hours:
Monday – Thursday (10:00 a.m. – 8:00 p.m.)
Friday – Saturday (10:00 a.m. – 5:00 p.m.)

For further information on LHAAP-18/24, please contact:

Dr. Rose M. Zeiler
Site Manager
Longhorn Army Ammunition Plant
P.O. Box 220
Ratcliff, Arkansas 72951

Direct No.: (479) 635-0110
E-mail address: rose.m.zeiler.civ@mail.mil

The preparation and review of a Proposed Plan is a distinct step required by CERCLA. This Proposed Plan provides background information that can be found in greater detail in the Remedial Investigation (RI) Report (2001), the Post-Screening Investigations (PSIs) (conducted in 2013-2014 and 2016), the Feasibility Study (FS) (2017), and other supporting documents that are contained in the LHAAP-18/24 Administrative Record and is publicly available in the Marshall, Texas Public Library and on the Longhorn AAP Environmental

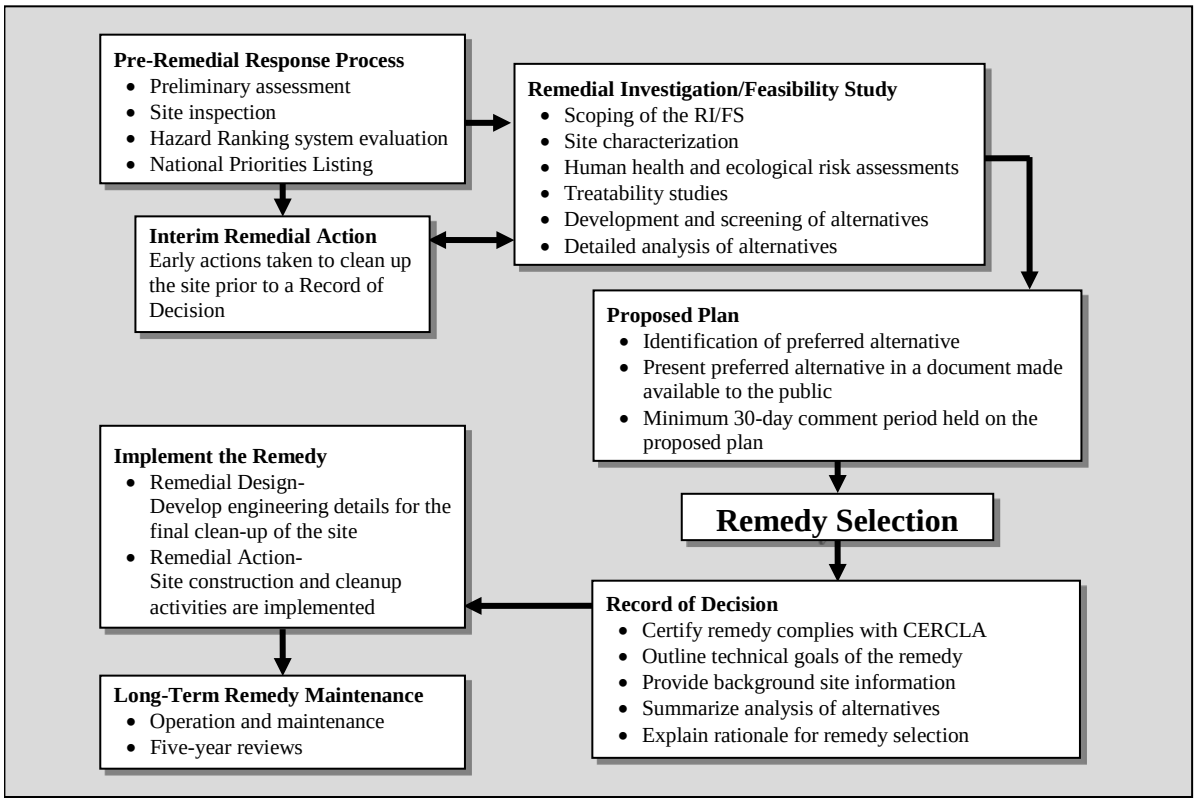

Figure 1. CERCLA Remedial Response Process for Site Cleanup

Restoration Program website http://www.longhornaap.com/. The project management team, including the U.S. Army, U.S. Environmental Protection Agency (USEPA), and the Texas Commission on Environmental Quality (TCEQ), encourages the public to review these documents and comment on the alternatives presented in this Proposed Plan.

The U.S. Army is acting in partnership with USEPA Region 6 (lead oversight agency) and TCEQ (support agency). As the lead agency for environmental response actions at LHAAP, the U.S. Army is charged with planning and implementing remedial actions at LHAAP. The regulatory agencies assist the U.S. Army by providing technical support, project review, project comment, and oversight in accordance with CERCLA and the NCP as well as the Federal Facility Agreement (FFA).

The Proposed Plan summarizes site characteristics, scope and role of the response action, and site risks. This is followed by a presentation of the remedial action objectives (RAOs) and a summary of remedial alternatives for LHAAP-18/24. Finally, an evaluation of alternatives and a summary of the preferred alternative are presented.

SITE BACKGROUND

LHAAP is located in central-east Texas in the northeastern corner of Harrison County (**Figure 2**). The installation occupies approximately 1,300 of its former 8,416 acres between State Highway 43 at Karnack, Texas, and the western shore of Caddo Lake. The nearest cities are Marshall, Texas, approximately 14 miles

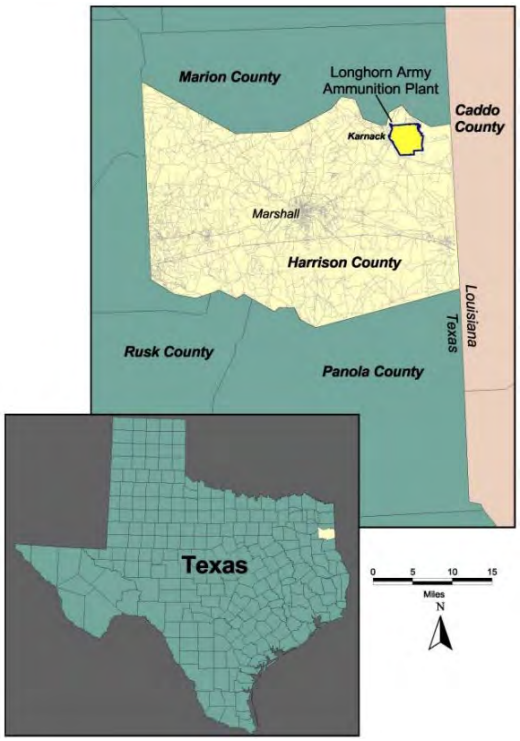

Figure 2. Location of the Longhorn Army Ammunition Plant, Harrison County, Texas

to the southwest, and Shreveport, Louisiana, approximately 40 miles to the southeast. Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east (AECOM, 2017).

The U.S Army has transferred over 7,100 acres to the U.S. Fish and Wildlife Service (USFWS) for management as the Caddo Lake National Wildlife Refuge.

The property transfer process is continuing as responses are completed at individual sites. The local Restoration Advisory Board (RAB) has been kept informed of previous investigations at this site through quarterly meetings. Additionally, the administrative record is updated quarterly and is available at the local public library.

Due to releases of chemicals from facility operations, LHAAP was placed on the Superfund National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination associated with the listing of LHAAP as a Superfund site began in 1990. The U.S. Army, the USEPA, and the Texas Water Commission (currently known as the TCEQ) entered into a CERCLA Section 120 FFA for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property. LHAAP-18/24 is an NPL site and addressed in the FFA.

LHAAP-18/24, known as the Burning Ground No. 3 (18) and Unlined Evaporation Pond (UEP) (24), is a 34.5 acre fenced, cleared area (containment area) located in the southeastern section of LHAAP (**Figure 3**). The area was used for the treatment, storage, and disposal of solid and liquid explosive, pyrotechnic, and combustible solvent waste by open burning/open detonation, incineration, evaporation, and burial (Jacobs, 2001).

LHAAP-18 Burning Ground No. 3 operated between 1955 and 1998. Historical waste management units within LHAAP-18 included open burn pits, stockpiles of solvent-soaked sawdust, and an air curtain destructor (ACD). The LHAAP- 24 UEP was used to collect water from the washout of rocket motor casings and process waste sumps from 1963 to 1984. A groundwater extraction system incorporating approximately 5,000 feet of interceptor-collection trenches (ICTs) and a groundwater treatment plant (GWTP) was installed in 1997 to control the migration of contaminated groundwater (AECOM, 2016). The area within the ICTs is considered the containment area (**Figure 3**).

Numerous investigations have been conducted at the site since 1976. The UEP was closed in 1986 with the removal of sludge and capping the impoundment. The

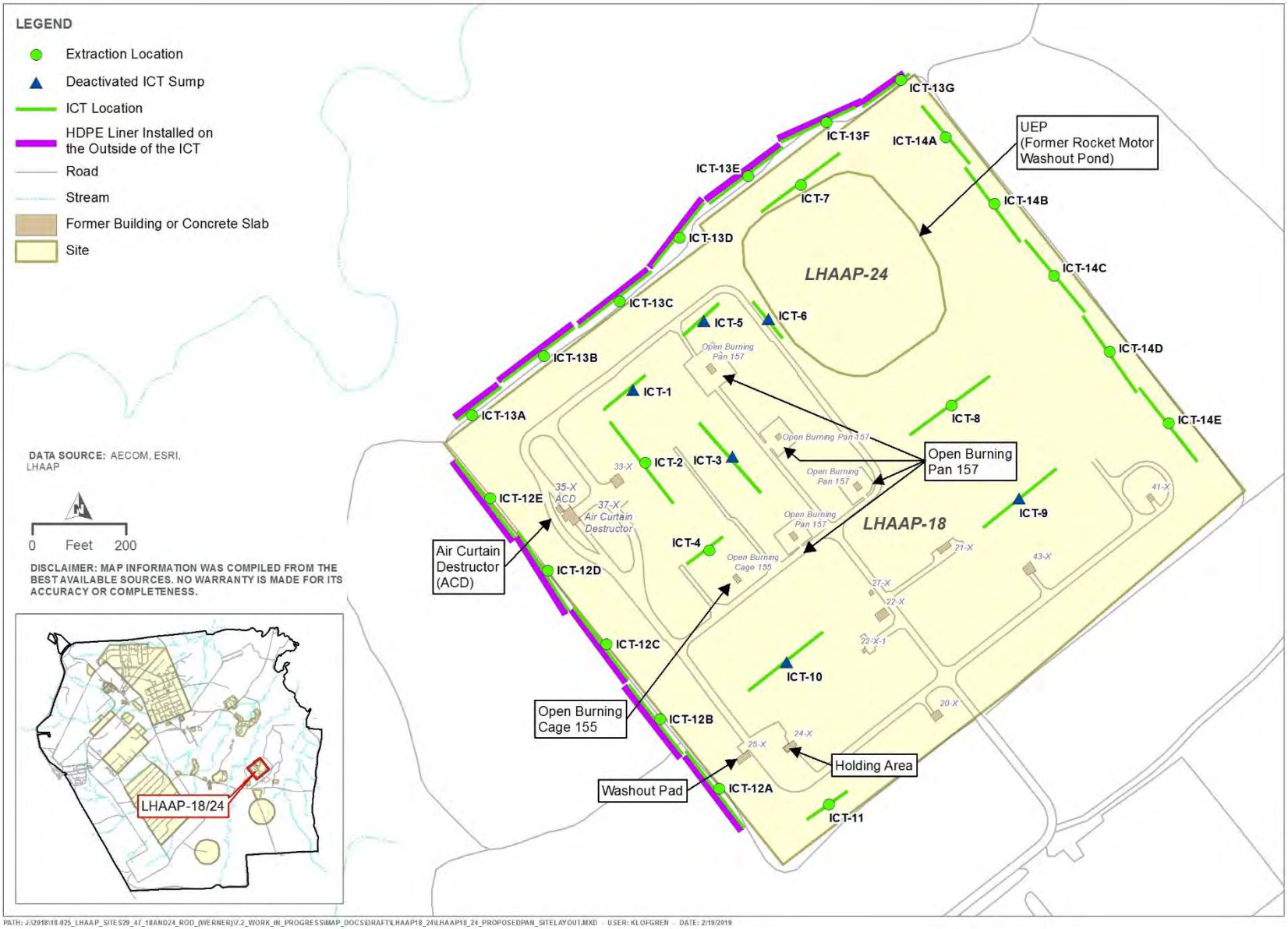

Figure 3. LHAAP-18/24 Layout

majority of impacts to the soil (i.e., source areas) were remediated during the 1997 LHAAP-18/24 Interim Remedial Action (IRA) where approximately 32,000 cubic yards of soil was removed (AECOM, 2017). The collective investigation results have identified impacts to soil, Shallow Zone groundwater, and underlying Wilcox Formation groundwater.

SITE CHARACTERISTICS

LHAAP-18/24 is a cleared area within a heavily wooded section of LHAAP. The area is vegetated primarily with grass and has asphalt-paved roads. It is situated on a natural topographic high slightly west of the crest of a small topographic divide between Harrison Bayou and Saunders Branch. Topography of the site has been altered by operations over the past 35 years. The burning ground area is mostly level with more relief near the western corner and near the northern corner that contains the mounded surface of the former UEP. There are no surface water bodies or watercourses running through LHAAP-18/24. Surface drainage occurs in all directions, but flow is generally directed to the north and west by both natural and manmade ditches and drainage swales towards Harrison Bayou. Harrison Bayou drains into Caddo Lake which is located approximately 2.5-miles northeast of LHAAP-18/24 (Jacobs, 2001).

Surficial soils at LHAAP-18/24 consist of sandy silty clays and clays underlain by sandy silt to silty sand. Soil borings completed near the UEP indicate that it was constructed within these silty clayey surficial soils. Saturated sandy silt to silty sand underlying surficial clayey soil comprises the Shallow Zone groundwater. The shallow saturated zone ranges in thickness from 10-to 20-feet thick. A semi-confining clay layer is encountered below the Upper Zone. This clay layer tends to act as an aquitard between the Shallow Zone and underlying Wilcox Formation saturated zone. This semi-confining clay layer varies approximately 5-to 15-feet thick and appears to be continuous beneath the site with the exception of the west corner of the site near the area of the ACD and the northwest corner or area, outside of containment area, between LHAAP-18/24 and Harrison Bayou (Jacobs, 2001). The Wilcox Formation saturated zone varies from 10-to 35-feet thick and is underlain by a layer of clay interbedded with sand lenses that extend to the top of the Midway Formation.

Groundwater in the Shallow Zone flows radially outward in a complex pattern from the site. Shallow groundwater flow in the northwest area of the site is towards Harrison Bayou. The ICTs installed in 1997 are designed to prevent discharge of groundwater from LHAAP-18/24 to surface water (AECOM, 2016). Groundwater flow in the Wilcox Formation indicates that the gradient and direction of flow in the northern portion of the site to be similar to the Shallow Zone toward Harrison Bayou. The groundwater flow pattern and gradient direction in the Wilcox Formation prior to installation of the groundwater extraction system was similar to what is observed today (AECOM, 2017).

Soil Summary

Investigations identified remaining vadose zone contaminant source areas and include the areas immediately to the west and south of the former ACD, which were not excavated as part of the IRA, and in areas immediately to the south, west and beneath the former UEP.

Analysis of the data indicated the majority of chemicals of concern (COCs) in the soil of these areas do not constitute source areas because either 1) the soil was identified to be present within the

groundwater zone, such as to the west of the ACD and 2) data indicate the soil concentration decreases with depth and does not constitute a source, such as to the south of the ACD.

The 2016 PSI study focused on the southern area to determine the extent of perchlorate contamination primarily in the Shallow Zone. For the unsaturated soil samples, the results were less than the GWP-Ind (groundwater protection – industrial use) MSC (medium-specific concentration) values. For the saturated soil samples, there were two samples with detections above the GWP-Ind MSC values. Both samples were collected from the Wilcox clay in the southern corner of the site just outside of the containment area. Analysis of soil samples collected in 2013 and 2014 indicated the potential presence of residual dense non-aqueous phase liquid (DNAPL) in the saturated shallow zone at the UEP and ACD. Dissolution of residual DNAPL trichloroethylene (TCE) and methylene chloride from the UEP and ACD areas is considered to be a continuing groundwater contaminant source. The extent of DNAPL in the UEP area is approximately 35,500 square feet and the extent of DNAPL in the ACD area is approximately 5,000 square feet.

Groundwater Summary

COCs were detected in monitoring wells within the Shallow Zone and Wilcox Formation. TCE, methylene chloride, and perchlorate present the vast majority of the human health risk in groundwater (**Figures 4** and **5**). The concentrations of TCE and methylene chloride in some portions of the site are sufficiently high to indicate the possible presence of DNAPL within the saturated zone. Occurrences of other volatile organic compounds (VOCs) and metals concentrations in groundwater are intermittent and their distribution is generally not contiguous across the site.

Three areas with high perchlorate concentrations were identified in the Shallow Zone wells. These areas include the area to the east of the former UEP (outside containment), in the vicinity of the former ACD, and the area southwest of the site where washout pads and sumps were operated at Building 24-x and 25-x. Perchlorate was detected at high concentrations in several Wilcox Formation wells including the area on the north side of the UEP, west of the former ACD, and south corner of the site.

The horizontal extent of TCE contamination in shallow groundwater covers the entire containment area and extends to areas southwest, northwest, and northeast outside of the containment area. The highest TCE concentrations in the shallow zone are found south of the UEP and west of the ACD. Within the Wilcox water-bearing zone, the highest TCE concentrations are found north and south of the UEP, west of the ACD and to the south near Burning Cage 155.

High concentrations of methylene chloride in the shallow and Wilcox water-bearing zones reside in two areas at the site and include the area southeast of the former UEP and west of the former ACD.

1,4-Dioxane is primarily located to the north of the ACD area in the shallow and Wilcox water-bearing zones.

SCOPE AND ROLE OF THE PROPOSED ACTION

The scope and role of the action discussed in this Proposed Plan includes all the remedial actions planned for this site. The preferred remedial action at LHAAP-18/24 will prevent potential risks associated with exposure to contaminated soil and groundwater in both the Shallow

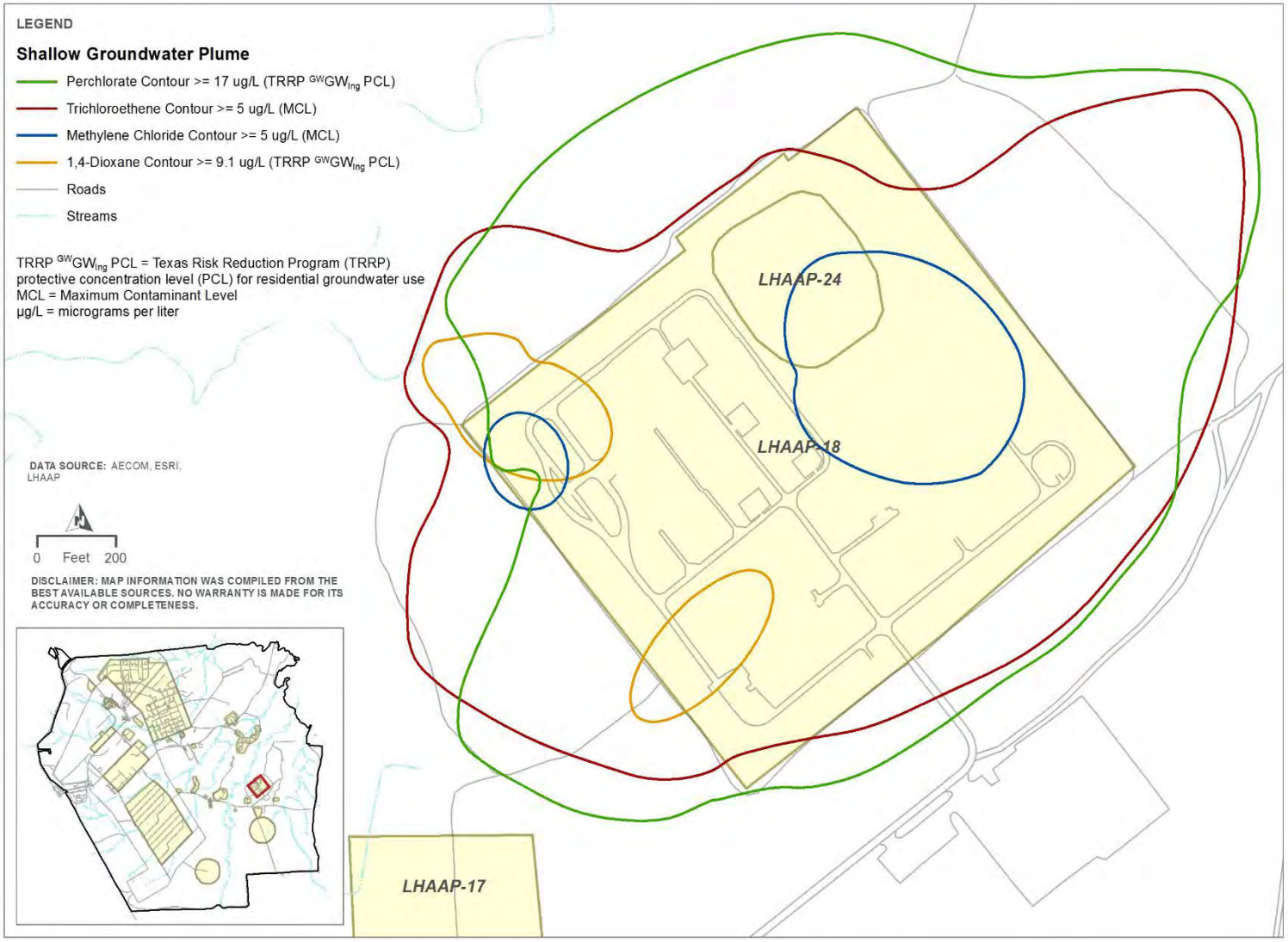

Figure 4. LHAAP-18/24 Shallow Zone Groundwater Contamination

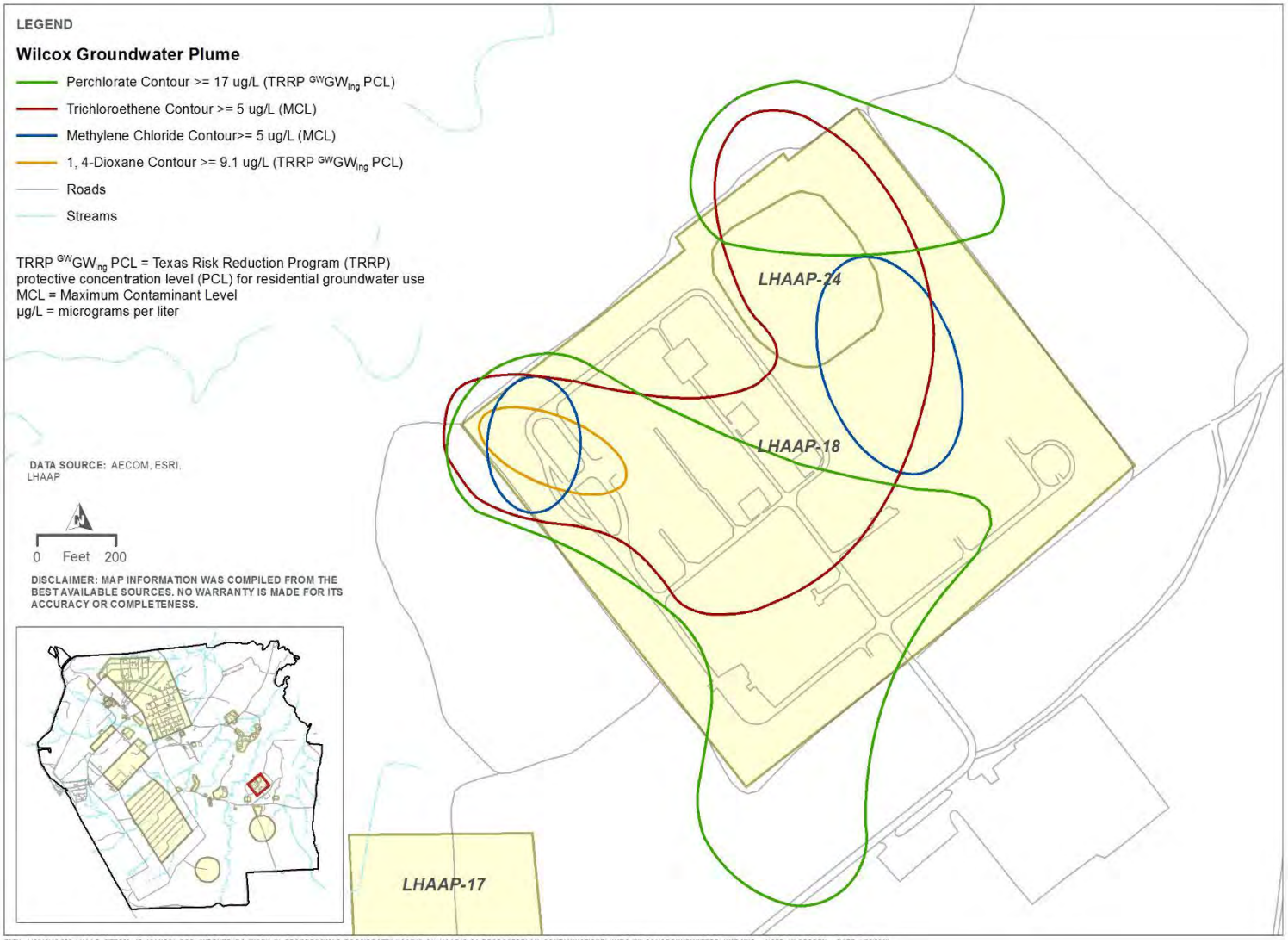

Figure 5. LHAAP-18/24 Wilcox Formation Groundwater Contamination

Zone and Wilcox Formation and also prevents contaminated groundwater from migrating and impacting surface water. Through the use of treatment technologies, this response will permanently reduce the toxicity, mobility, and volume of source materials that constitute the principal threat wastes at the site.

Groundwater at LHAAP is not currently being used as drinking water, nor is it anticipated to be used in the future based on its reasonably anticipated use as a national wildlife refuge. However, when establishing the RAOs for this response action, the U.S. Army has considered the NCP's expectation to return groundwater to its beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. The U.S. Army has also considered the State of Texas designation of all groundwater as potential drinking water, unless otherwise classified, consistent with Texas Administrative Code, Title 30, §335.563 (h)(1). The Army intends to return the contaminated shallow and Wilcox Formation groundwater zones at LHAAP-18/24 to its potential beneficial uses, which is considered to be the attainment of Safe Drinking Water Act Maximum Contaminant Levels (MCLs) to the extent practicable, and consistent with 40 CFR §300.430(e)(2) (i)(B&C). If an MCL is not available for a chemical, the Texas Risk Reduction Program (TRRP) Tier 1 Protective Concentration Level (PCL) for residential groundwater use ($^{GW}GW_{Ing}$) will be used. If return to potential beneficial use is not practicable, the NCP expectation is to prevent further migration of the plume, prevent exposure to contaminated groundwater, and evaluate further risk reduction.

The preferred final remedial action at LHAAP-18/24 will prevent potential exposure risks associated with the contaminated groundwater, and demonstrate through groundwater and surface water monitoring activities that the nearby surface water body, Harrison Bayou, is protected from exceedances of cleanup levels. Groundwater monitoring will also verify that contaminant levels are being reduced. LUCs that restrict groundwater use will be maintained until COC levels in soil and groundwater allow for unrestricted use and unlimited exposure. The thermal treatment of residual DNAPL source areas will positively impact groundwater by eliminating the potential for the continued dissolution of COCs to groundwater. The removal of source soils will positively impact groundwater by eliminating the potential for the leaching of contaminants from the soil into groundwater.

SUMMARY OF SITE RISKS

Results of the Baseline Human Health and Screening Ecological Risk Assessment (BHHRA, 40 CFR 300.430(e)) determined the primary environmental issue at LHAAP-18/24 is contaminated groundwater posing an unacceptable risk or hazard to the hypothetical future maintenance worker under an industrial scenario.

Groundwater

COCs in the Shallow Zone groundwater include the following:

VOCs

- methylene chloride
- TCE
- cis-1,2-dichloroethylene (DCE)
- tetrachloroethylene (PCE)
- benzene
- 1,1,2-trichloroethane (TCA)
- vinyl chloride
- bromodichloromethane
- 1,3,5-trinitrobenzene
- 1,4-dioxane

Metals

- arsenic
- barium
- chromium
- cobalt
- nickel

Anions

- perchlorate

In the underlying Wilcox Formation, COCs in groundwater include the following:

VOCs

- methylene chloride
- TCE
- cis 1,2-DCE
- PCE
- benzene
- 1,1,2-TCA
- 1,1,1,2-tetrachloroethane
- vinyl chloride
- bromodichloromethane
- 1,3,5-trinitrobenzene
- 1,4-dioxane

Metals

- arsenic
- barium
- cobalt

Anions

- perchlorate

The proposed cleanup level is the MCL, where it exists (42 U.S.C. §9621(d)(2)(A)). Where an MCL has not been promulgated, the TRRP Tier 1 PCL for residential groundwater use (TRRP $^{GW}GW_{Ing}$ PCL) will be used. The maximum detected concentrations of the COCs from the June 2016 sampling event and the MCLs or TRRP $^{GW}GW_{Ing}$ PCL for the Shallow Zone and the Wilcox Formation are presented in **Tables 1** and **2**, respectively. Bromodichloromethane, 1,3,5-trinitrobenzene, arsenic, and cobalt have been retained on a provisional basis, because the concentrations above the cleanup level are only detected sporadically (cobalt), no recent results are

Table 1. Shallow Zone Groundwater Chemicals of Concern

Chemical	Maximum Concentration (µg/L)	MCL (µg/L)
Methylene chloride	21,300	5
Trichloroethylene	17,100	5
cis-1,2-Dichloroethene*	43,600	70
Tetrachloroethylene	85.1	5
Benzene	<62.6	5
1,1,2-Trichloroethane	<50	5
Vinyl chloride*	256	2
Arsenic	16.1	10
Barium	10,300	2,000
Chromium	4,620	100
		TRRP $^{GW}GW_{Ing}$ PCL** (µg/L)
Bromodichloromethane	<125	15
1,3,5-trinitrobenzene	No recent data	730
1,4-Dioxane	220	9.1
Cobalt	355	240
Nickel	14,300	490
Perchlorate	82,900	17

Notes:
* trichloroethylene daughter products
**TRRP $^{GW}GW_{Ing}$ PCL from April 2018, https://www.tceq.texas.gov/remediation/trrp/trrppcls.html
µg/L micrograms per liter
MCL maximum contaminant level
NA Not Available
Samples collected June 2016 (AECOM, 2016b)

Table 2. Wilcox Formation Groundwater Chemicals of Concern

Chemical	Maximum Concentration (µg/L)	MCL (µg/L)
Methylene chloride	746	5
Trichloroethylene	15,900	5
cis-1,2-Dichloroethene*	2,600	70
Benzene	6.13	5
1,1,2-Trichloroethane	0.858	5
Vinyl chloride*	8.97	2
Arsenic	17.3	10
Barium	10,300	2,000
		TRRP $^{GW}GW_{Ing}$ PCL** (µg/L)
Bromodichloromethane	<40	15
1,1,1,2-Tetrachloroethane	<50	35
1,3,5-trinitrobenzene	No recent data	730
1,4-Dioxane	412	9.1
Cobalt	9.64	240
Perchlorate	229,000	17

Notes:
* trichloroethylene daughter products
**TRRP $^{GW}GW_{Ing}$ PCL from April 2018, https://www.tceq.texas.gov/remediation/trrp/trrppcls.html
µg/L micrograms per liter
MCL maximum contaminant level
NA Not Available
Samples collected June 2016 (AECOM, 2016b)

available (1,3,5-trinitrobenzene), detection limits for recent results were above the cleanup levels (bromodichloromethane), or the COC is not associated with the site (arsenic).

For the hypothetical future maintenance worker's exposure to groundwater, the carcinogenic risk and non-carcinogenic hazard exceed the acceptable limits. The total carcinogenic risk was determined at 4.4×10^{-1}, with TCE and methylene chloride contributing 99.98% of the risk. The total Hazard Index (HI) was calculated at 3,200, with methylene chloride, TCE, and perchlorate contributing greater than 98% of the HI. The reason for the high cancer risk and hazard index calculated for the hypothetical maintenance worker was related to the unlikely assumption that groundwater extracted from the site would be used by the maintenance worker for showering, during which dermal and inhalation exposure to the contaminants in groundwater would occur. The Installation-Wide Baseline Ecological Risk Assessment did not identify potential risk to ecological receptors at LHAAP-18/24.

Soil

For the hypothetical future maintenance worker's exposure to soil at LHAAP-18/24, the carcinogenic risk was determined to be 5.0×10^{-7} and a non-carcinogenic hazard of 0.042; therefore, chemicals in soil do not pose unacceptable carcinogenic risk or non-carcinogenic hazard to human health. The potential soil-to-groundwater pathway was evaluated for TCE, methylene chloride (MC), PCE and perchlorate. The concentrations of these chemicals were compared to their TCEQ soil MSCs for industrial use based on groundwater protection (GWP-Ind MSC), which are more stringent than the soil MSCs for industrial use based on inhalation, ingestion, and dermal contact (TCEQ, 2006). Because the GWP-Ind MSC values are more stringent, they are the proposed soil cleanup levels. The maximum detected concentrations of the COCs in unsaturated soil and GWP-Ind MSC (proposed as the cleanup levels) are presented in **Table 3**.

Table 3. Soil Chemicals of Concern

Chemical	Location and Depth (feet bgs)	Maximum Concentration (mg/kg)	GWP-Ind MSC (mg/kg)
Methylene Chloride[1]	18CPTUEP05[1], 24-25	3.42	0.5
Trichloroethylene	18CPT21[2], 16-17	11.6	0.5
Perchlorate	18CPTBB02[1], 4.5-5.5	18.7	7.2
Tetrachloroethene	18CPT21[2], 16-17	71.3	0.5

Notes:
[1] Sample collected 5/2014
[2] Sample collected 3/2013
bgs below ground surface
mg/kg milligrams per kilogram
GWP-Ind MSC Texas Commission on Environmental Quality soil medium-specific concentration (MSC) for industrial use based on groundwater protection

It is the current judgment of the U.S. Army that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES

The future use of the entire LHAAP facility is as a National Wildlife Refuge. The RAOs for LHAAP-18/24, which address contamination associated with the media at the site and take into account the future uses of LHAAP streams, land, and groundwater are as follows:

Groundwater

- Protect human health by preventing human exposure to the groundwater contaminated with COCs,
- Protect human health and the environment by preventing groundwater contaminated with COCs from migrating into nearby surface water,
- Return groundwater to its beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site (40 CFR 300.430(a)((1)(iii)(F)).

Soil

- Protect human health and the environment by preventing the migration of contaminants to groundwater from potential sources in the soil.

SUMMARY OF REMEDIAL ALTERNATIVES

The Revised FS identified and screened remedial technologies and associated process options that may be appropriate for satisfying the RAOs for LHAAP-18/24 with respect to effectiveness, implementability, and cost. All costs presented herein are based on 30 years of implementation only. For alternatives taking longer than 30 years to achieve RAOs, costs would be considerably higher. The following remedial alternatives were developed from the retained remedial technologies carried forward after the initial screening:

- **Alternative 1** – No Action, as required by the NCP.
- **Alternative 2** – Enhanced Groundwater Extraction and Ex-Situ Treatment, LUCs in the Shallow Zone and Wilcox Formation, EISB Inside & Outside the Containment Area in the Shallow Zone and in the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal.
- **Alternative 3** – Groundwater Extraction and Treatment, Monitored Natural Attenuation (MNA) Outside the Containment Area in the Shallow Zone and in Wilcox Formation, LUCs in the Shallow Zone and Wilcox Formation, and Containment.
- **Alternative 4** – Enhanced Groundwater Extraction and Treatment, LUCs in the Shallow Zone and Wilcox Formation, EISB Inside & Outside the Containment Area in the Shallow Zone and in the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, and Surfactant Enhanced DNAPL Removal.
- **Alternative 5** – Enhanced Groundwater Extraction and Treatment, LUCs in the Shallow Zone and Wilcox Formation, EISB Inside and Outside the Containment Area in the Shallow Zone and in the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, Thermal DNAPL Removal.
- **Alternative 6** – Enhanced Groundwater Extraction and Treatment, LUCs in the Shallow Zone and Wilcox Formation, EISB Inside and Outside the Containment Area in the Shallow Zone and in the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, Enhanced DNAPL Remediation using Zero-Valent Iron (ZVI).

Common Elements. There are a number of remedial process options that are common to many of these six remedial alternatives and are summarized in **Table 4**.

A number of process options are common to all action alternatives (Alternatives 2 through 6):

- Maintenance of the existing cap over the former UEP.
- MNA that occurs at the site to reduce and control COC concentrations in areas outside the direct influence of the containment area. MNA was evaluated and is a viable option for those areas but not as a primary remedy as additional evidence is needed for MNA to be used as a primary remedy. MNA for 1,4-dioxane has not been established at this time.
- LUCs will be implemented to support the RAOs. The U.S. Army will be responsible for implementation, maintenance, inspection, reporting, and enforcement of the LUCs. The U.S. Army intends to provide details of the LUC implementation actions in a Remedial Design (RD) document. Until cleanup levels are met in the groundwater for Alternatives 2 through 6, the LUCs will prevent human exposure to residual groundwater contamination presenting an unacceptable risk to human health by ensuring there is no withdrawal or use of groundwater beneath the site for anything other than treatment, environmental monitoring, or testing.

  The LUC objectives include maintaining the integrity of any current or future remedial or monitoring systems, and preventing the use of groundwater contaminated above cleanup levels as a potable water source.

  - LUC to restrict land use to non-residential use until it is demonstrated that the COCs in soil and groundwater are at levels that allow for unlimited use and unrestricted exposure.
  - LUC prohibiting potable use of groundwater above cleanup levels until it is demonstrated that the COCs are at levels that allow for unlimited use and unrestricted exposure.
  - LUC to maintain the remedial and monitoring systems associated with the groundwater remedies until these components of the remedy are no longer needed to achieve cleanup levels, and cleanup levels have been achieved.

In addition, the Texas Department of Licensing and Regulation will be requested to notify well drillers of groundwater restrictions. The recordation of the LUCs with the Harrison County Courthouse will be completed and will include a map showing the areas of groundwater restriction at the site. These restrictions will prohibit or restrict property uses that may result in exposure to the contaminated groundwater.

In order to transfer this property (LHAAP-18/24), an environmental condition of property (ECP) document will be prepared and the Environmental Protection Provisions from the ECP will be attached to the letter of transfer. The ECP will include LUCs for groundwater soil, and the remedial and monitoring system as part of the Environmental Protection Provisions. The property will be transferred subject to the LUCs identified in the ECP. These restrictions will prohibit or restrict

Table 4. Common Remedial Process Options for Remedial Alternatives

Media	Remedial Process Option	Remedial Alternative					
		1	2	3	4	5	6
Groundwater	Continue operation of the current or a new groundwater extraction and treatment system with contingent 1,4-dioxane treatment component.	--	X	X	X	X	X
	Slurry wall groundwater containment; improve ground surface to promote runoff.	--		X			
	EISB inside containment in Shallow Zone and Wilcox Formation, and EISB outside containment.	--	X		X	X	X
	MNA and LUCs until cleanup levels are met.	--	X	X	X	X	X
Soil (vadose zone)	Maintain cap over former UEP.	--	X	X	X	X	X
	Cap additional area to reduce infiltration.	--		X			
	Excavate source areas.	--	X		X	X	X
	Excavate soil under UEP.	--	X		X	X	X
Soil (residual DNAPL in saturated zone)	DNAPL removal via extraction, surfactant flushing, ZVI, or ERH.	--	X		X	X	X
	EISB.	--			X	X	X

property uses that may result in exposure to the contaminated groundwater and any residual soil contamination greater than levels that allow for unlimited use and unrestricted exposure. Although the U.S. Army may later pass these procedural responsibilities to the transferee by property transfer agreement, the U.S. Army will retain ultimate responsibility for remedy integrity.

- Operation of the existing GWTP and associated groundwater extraction system. The intensity and duration of continued use varies within the alternatives.

Alternative 1 – No Action.

Estimated Capital Cost: $0
Estimated Annual Operation and Maintenance (O&M) Cost: $0
Estimated Present Worth Cost: $0
Estimated Time to Achieve RAOs: Not Achievable

Contaminated groundwater and source areas in the saturated and unsaturated soil would be left in place with no remedial action or additional measures to prevent exposure to the COCs or to prevent migration. The No Action alternative serves as a baseline for comparison with other alternatives as required by the NCP (40 CFR 300.430(e)). The No Action alternative does not meet the RAOs.

Alternative 2 – Enhanced Groundwater Extraction and Ex-Situ Treatment, Land Use Controls (LUCs), Enhanced In-Situ Bioremediation (EISB) Inside & Outside Containment Area and in Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal.

Estimated Capital Cost: $14.56M
Estimated Annual Operation and Maintenance (O&M) Cost: $19.6
Estimated Present Worth Cost: $34.16M
Estimated Time to Achieve RAOs: Several hundred years

Under Alternative 2, the existing groundwater extraction and treatment system would continue operating for contaminant removal, hydraulic control, and groundwater treatment. Previously inactivated interception collection trenches (ICT3 and ICT9) would potentially be phased in for reactivation to remove more contaminant mass from groundwater. Saturated soil contaminated with VOCs or perchlorate at high concentrations that may be acting as a

source of groundwater contamination (one area in the UEP vicinity and another area in the ACD vicinity) would be remediated by groundwater extraction using vertical extraction wells. LUCs would be implemented to restrict land use to nonresidential uses until it is demonstrated that COCs in soil and groundwater are at levels that allow for unlimited use and unrestricted exposure. Maintenance of the UEP cover will continue. EISB would be conducted in Shallow Zone contaminated areas inside and outside the containment area and in three or more areas in the Wilcox Formation. Unsaturated soil in two areas south of the UEP and two areas to the west of the UEP would be excavated and disposed off-site. The cost estimate for two soil areas beneath the UEP will be developed but the actual implementation would be deferred to year 6 of remedy implementation at the earliest. In the interim, maintenance of the UEP cap will continue. Continued operation of current or potentially a new GWTP, including contingency use of advanced oxidation process for treatment of 1,4-dioxane is included in this alternative.

This alternative is estimated to take between 300 and 500 years to achieve RAOs. LUCs would be implemented along with maintenance of the UEP cover to prevent human exposure to contaminated groundwater.

Alternative 3 – Groundwater Extraction and Treatment, Containment (slurry wall), MNA outside the containment and in Wilcox Formation, and LUCs.

Estimated Capital Cost: $6.41M
Estimated Annual Operation and Maintenance (O&M) Cost: $12.24M
Estimated Present Worth Cost: $18.65M
Estimated Time to Achieve RAOs: Several hundred years

Alternative 3 would include the installation of a slurry wall to contain contaminated groundwater in the Shallow Zone; additional soil cover would be added to portions of the site and the drainage ditches would be improved to promote runoff and reduce infiltration. The slurry wall would be tied into the clay layer, where present, that separates the Shallow Zone from the Wilcox aquifer. Where the clay layer is not present, the slurry wall would be installed to a depth just below the bottom depth of Harrison Bayou to the north of the containment. The existing groundwater extraction system would be used as needed to maintain hydraulic control inside the slurry wall, and would be ramped down gradually to an approximate 65% extraction rate (actual rate that would be required to achieve an inward and upward gradient would be determined with a 2-year hydraulic evaluation). MNA would ensure that groundwater contamination remains localized for the areas outside the slurry wall and within the Wilcox Formation. This alternative would take a very long time (several hundred years) to achieve RAOs. Continued operation of the current or potentially a new GWTP, including contingency use of advanced oxidation process for treatment of 1,4-dioxane is included in this alternative. LUCs would be implemented to restrict land use to nonresidential uses until it is demonstrated that COCs in soil and groundwater are at levels that allow for unlimited use and unrestricted exposure. Maintenance of the UEP cap will continue.

Alternative 4 – Enhanced Groundwater Extraction and Treatment, LUCs, EISB Inside & Outside Containment Area and in Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, and Surfactant Enhanced DNAPL Removal.

Estimated Capital Cost: $13.11M

Estimated Annual Operation and Maintenance (O&M) Cost: $19.39M
Estimated Present Worth Cost: $32.5M
Estimated Time to Achieve RAOs: 30+ years

Alternative 4 would employ surfactant flushing technology to treat saturated soil contaminated with VOCs or perchlorate at high concentrations in the vicinity of the UEP and ACD. EISB will also be applied to these areas after completion of surfactant flushing as a polishing step because surfactant flushing effectiveness might be hindered by low permeability zones and to remove perchlorate that has not been treated via surfactant flushing. EISB would be conducted in Shallow Zone contaminated areas inside and outside the containment area and in three or more areas in the Wilcox Formation. Unsaturated soil in two areas south of the UEP, two areas to the west of the UEP, and two areas beneath the UEP would be excavated and disposed off-site. The actual implementation of the soil excavation would be deferred to year 6 of remedy implementation at the earliest. Maintenance of the UEP cap would continue. The groundwater extraction system in its enhanced form (with potential phased reactivation of ICT 3 and ICT 9) would continue operating to maintain hydraulic control and remove remaining Shallow Zone contaminants within the containment area. Continued operation of the current or potentially a new GWTP, including contingency use of advanced oxidation process for treatment of 1,4-dioxane is included in this alternative. This alternative would achieve site RAOs more quickly than Alternatives 2 and 3, but is expected to exceed 30 years. LUCs would be implemented to restrict land use to nonresidential uses until it is demonstrated that COCs in soil and groundwater are at levels that allow for unlimited use and unrestricted exposure. Maintenance of the UEP cover will continue.

Alternative 5 – Enhanced Groundwater Extraction and Treatment, LUCs, EISB Inside and Outside Containment Area and in Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, Thermal DNAPL Removal.

Estimated Capital Cost: $19.52M
Estimated Annual Operation and Maintenance (O&M) Cost: $13.15M
Estimated Present Worth Cost: $32.67M
Estimated Time to Achieve RAOs: 20 years

Alternative 5 is the same as Alternative 4 with the exception that thermal treatment is applied at the residual DNAPL source areas of the UEP and ACD instead of surfactant flushing. Under Alternative 5, two in-situ thermal desorption (ISTD) technologies (Electrical Resistance Heating [ERH] or Thermal Conduction Heating [TCH]) may be considered to treat the high concentration dissolved VOCs and DNAPL in the Shallow Zone and Wilcox groundwater. While the technology is more expensive, it is very effective in low permeability zones where the majority of the residual DNAPL resides. A removal rate of 99.9% is expected. EISB would be applied to the thermally-treated areas as a polishing step after thermal treatment is completed. LUCs would be implemented to restrict land use to nonresidential uses until it is demonstrated that COCs in soil and groundwater are at levels that allow for unlimited use and unrestricted exposure. Maintenance of the UEP cap will continue. It is estimated that this alternative allows achievement of the RAOs within 20 years.

Alternative 6 – Enhanced Groundwater Extraction and Treatment, LUCs, EISB Inside and Outside Containment Area and in Wilcox Formation, Unsaturated

Soil Excavation and Off-Site Disposal, Enhanced DNAPL Remediation using Zero-Valent Iron (ZVI).

Estimated Capital Cost: $102.23M
Estimated Annual Operation and Maintenance (O&M) Cost: $19.39M
Estimated Present Worth Cost: $121.62M
Estimated Time to Achieve RAOs: 30 years

Alternative 6 is the same as Alternative 5 but instead of using in-situ thermal remediation, ZVI for treatment of residual DNAPL source areas would be used. Uniform distribution of ZVI in low permeability zones may not be possible due to subsurface heterogeneity and therefore, effective remediation of these areas by ZVI may not be effective. Hence, EISB would be applied to these areas after ZVI remediation is completed as a polishing step. It is estimated that 70% to 80% reduction in CoCs would occur after each injection of ZVI with two injections planned for the site. LUCs would be implemented to restrict land use to nonresidential uses until it is demonstrated that COCs in soil and groundwater are at levels that allow for unlimited use and unrestricted exposure. Maintenance of the UEP cap will continue. With application of EISB after the ZVI, it is estimated that this alternative allows achievement of the RAOs within 30 years.

EVALUATION OF ALTERNATIVES

Nine criteria identified in the NCP, 40 CFR §300.430(e)(9)(iii), are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. This section profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other alternatives under consideration. The nine evaluation criteria are discussed below. The "Detailed Analysis of Alternatives" can be found in the Revised FS for LHAAP-18/24 (AECOM, 2017).

1. Overall Protection of Human Health and the Environment

The six alternatives provide varying levels of human health protection. Alternative 1, No Action, does not achieve the RAOs and provides the least protection of all the alternatives; it provides no reduction in risks to human health and the environment because no measures would be implemented to eliminate potential exposure pathways for human exposure to the groundwater contamination or potential migration of COCs from groundwater to surface water.

All five action alternatives protect human health and the environment. The action alternatives implement LUCs to prevent access to the Shallow Zone and Wilcox Formation groundwater until cleanup levels are achieved. MNA will continue to ensure the plume originating within the containment area is stable and contained. Operation of the GWTP will continue to ensure the plume originating within the containment area is stable and contained. Alternative 3, which relies the most heavily on containment and LUCs, does not provide the same degree of contaminant removal or treatment in groundwater as the other alternatives, but would be protective of human health because the LUCs would prevent human access to the contaminated groundwater in the Shallow Zone and Wilcox Formation. Alternative 3 prevents migration of COCs from groundwater outside containment to surface water, but does not prevent continued leaching from soil into the groundwater. The GWTP would provide hydraulic control. Alternatives 2, 4, 5, and 6 provide a similar level of overall protection and can eventually achieve the cleanup levels for the groundwater COCs due to active remediation and continued operation of the groundwater treatment

system for contaminant removal; however, the duration to achieve the cleanup levels vary. Remedial time frames span from hundreds of years for Alternatives 2 and 3, 30 years for Alternatives 4 and 6, and 20 years for Alternative 5.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The Applicable or Relevant and Appropriate Requirements can be found in the FS for LHAAP-18/24 (AECOM, 2017).

Alternative 1 does not comply with chemical-specific ARARs for groundwater, unsaturated soils, or secondary source within the saturated soil because no remedial measures would be implemented.

Alternative 3 is not expected to return groundwater concentrations within the slurry wall to less than the cleanup levels for several hundred years.

Alternatives 2, 4, 5, and 6 comply with the chemical-specific ARARs for groundwater, unsaturated soil, and secondary groundwater source (residual DNAPL) because they prevent exposure to groundwater that exceeds ARARs and would eventually return groundwater and soil concentrations to less than cleanup levels.

All of the action alternatives would comply with the action-specific ARARs.

3. Long-Term Effectiveness and Permanence

Alternative 1 would not be effective or permanent in the long term because no contaminant removal or treatment would take place and no measures would be implemented to control exposure to risks posed by contaminated groundwater or the potential for contaminated groundwater to migrate to Harrison Bayou.

Alternative 2 offers a moderate degree of long-term effectiveness through operation of an enhanced groundwater extraction (vertical extraction wells) and treatment system, EISB inside and outside the containment area and in the Wilcox Formation, in combination with unsaturated soil removal, residual DNAPL source removal, and LUC implementation, which would minimize the potential risk posed by the contaminated groundwater. Reduction of the residual DNAPL source with groundwater extraction is not highly effective and therefore, the potential for significant residual risk would remain.

Alternative 3 offers a degree of long-term effectiveness through physical containment of contaminated groundwater using a slurry wall and gradient control by pumping, combined with MNA to monitor effectiveness and LUCs to prevent groundwater use. Alternative 3 is designed to contain contaminated groundwater in place in perpetuity. While the exposure RAO would be satisfied by this alternative, the RAO for groundwater restoration would not be met within the slurry wall and would require operation of the GWTP for several hundred years. Therefore, the groundwater restoration RAO would need to be waived for this area.

Alternative 4 offers a higher degree of long-term effectiveness compared to Alternatives 2 and 3 through surfactant flushing of residual DNAPL, EISB of groundwater inside and outside the containment and in the Wilcox Formation including as a polishing step for the residual DNAPL areas in the Shallow Zone, unsaturated soil excavation, enhanced groundwater extraction and treatment system, and LUC implementation. Alternative 4 is likely to

achieve groundwater cleanup levels in a shorter period of time than Alternative 2. However, the period of time required to attain RAOs remains long because the effectiveness of surfactant flushing of residual DNAPL is uncertain due to the difficulty in reaching into the low permeability zones.

Alternative 5 offers the highest degree of long-term effectiveness through thermal remediation of VOCs in residual DNAPL saturated soil areas in groundwater, EISB of groundwater inside and outside the containment area and in the Wilcox Formation including as a polishing step for the residual DNAPL areas in the Shallow Zone, unsaturated soil excavation, enhanced groundwater extraction and treatment system, and LUC implementation. Alternative 5 would achieve groundwater cleanup levels in a shorter period of time than Alternatives 3 or 4 because 99.9% removal of VOCs from the residual DNAPL areas is possible.

Alternative 6 also offers a high degree of long-term effectiveness through application of ZVI to the residual DNAPL saturated soil areas, EISB of groundwater inside and outside the containment and in the Wilcox Formation including as a polishing step for the residual DNAPL areas in the shallow zone, unsaturated soil excavation, enhanced groundwater extraction and treatment, and LUC implementation. Alternative 6 relies on effective distribution of injected ZVI to all impacted areas. However, the ability to distribute injected ZVI into low permeability zones with high residual DNAPL may not be effective, and achieving results comparable to the treatability study results of greater than 99% reduction of TCE and high percentage reduction of MC and perchlorate is unlikely.

Alternative 5 is expected to require the shortest duration to achieve RAOs and allow shutdown of the GWTP. Alternatives 4 and 6, while rapidly addressing COCs in residual DNAPL areas, suffer from the difficulty of distributing the injected material to low permeability zones and may not be as effective as would be expected from a treatability test results where contact between the contaminants and the material is not limiting. Alternative 2 would not achieve the RAOs within an acceptable period of time, i.e., several hundred years. Alternative 3 would require several hundred years to achieve cleanup levels within the slurry wall, and, due to the risk of containment failure, would be the least permanent remedy.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 does not employ treatment in groundwater and would not result in a reduction of toxicity, mobility, or volume of contaminants. All of the action alternatives provide some degree of reduction of toxicity, mobility or volume through treatment. Alternative 2 provides a reduction in toxicity, mobility and volume via continued operation of an enhanced groundwater extraction and treatment system but the rate of reduction expected within the residual DNAPL areas would be slow.

Alternative 3 provides mobility reduction through the installation of a slurry wall and continued hydraulic control as needed. Reduction of volume through treatment is limited to natural attenuation mechanisms of contaminants outside the slurry wall and ex situ treatment of extracted groundwater from within the containment area.

Alternative 4 provides permanent reduction in toxicity and volume of the groundwater contaminants in a shorter

timeframe than Alternatives 2, and 3. This is achieved through surfactant flushing of saturated source soil to remove DNAPL that may serve as a long-term source of groundwater contamination, as well as excavation of unsaturated soil, and implementation of EISB in areas inside and outside the containment and within the Wilcox Formation. In addition to enhanced groundwater extraction, all the above technologies would result in a reduction in contaminant toxicity, mobility, and volume. However, only a partial reduction of mass of the residual DNAPL via surfactant flushing is expected to be achievable due to the difficulty of getting the surfactants to reach low permeability zones. Natural attenuation mechanisms of contamination outside the containment area would continue to act to reduce contaminant mass.

Alternative 5 provides the greatest reduction in toxicity, mobility, and volume of the groundwater contaminants compared to the other alternatives. This is achieved through thermal treatment of saturated source soil to treat DNAPL that may serve as a long-term source of groundwater contamination, excavation of unsaturated soil, and implementation of EISB in areas inside and outside the containment and within the Wilcox Formation. In addition to enhanced groundwater extraction, this technology would result in a reduction in contaminant toxicity, mobility, and volume. Natural attenuation mechanisms of contamination outside the containment area would continue to act to reduce contaminant mass.

Alternative 6 provides a high level of reduction in toxicity, mobility, and volume of the groundwater contaminants compared to the other alternatives but is expected to be less than that achieved by Alternative 5. Reduction of mass of residual DNAPL via ZVI injection is expected to be partial due to difficulty of the ZVI to effectively reach low permeability zones. Excavation of unsaturated soil and implementation of EISB in areas inside and outside the containment and within the Wilcox Formation, in addition to enhanced groundwater extraction would result in a reduction in contaminant toxicity, mobility, and volume. Natural attenuation mechanisms of contamination outside the containment area would continue to act to reduce contaminant mass.

5. Short-Term Effectiveness

Because Alternative 1 does not involve remedial measures, no short-term risk to workers, the community, or the environment would exist.

All of the action alternatives involve potential short-term risks to workers associated with exposure to contaminated groundwater, vapor (i.e., volatilized and extracted VOCs), from monitoring and/or operation of drilling/construction equipment.

Alternative 2 presents risks associated with drilling new extraction wells, trenching for placement of conduits, and potential exposure to contaminated groundwater or heavy equipment. Alternative 2 presents potential risks associated with soil excavation (particulate emissions, heavy equipment) and off-site disposal which represents a greater exposure potential to LHAAP-18/24 workers, a greater potential for runoff releases to the environment and the potential for offsite traffic accidents and impacts on communities between LHAAP and the disposal facility. Risks are also associated with handling of chemicals used for EISB, although these chemicals are typically food grade and not harmful. Use of application equipment can also present risks to workers.

Alternative 3 involves risks associated with operation of the heavier equipment used in slurry wall construction and with handling the bentonite slurry used in construction. Alternative 4 requires a large construction footprint and would result in disturbing a wide area along the path of construction which would have an impact on the environment. Control of run-on and run-off would be critical to prevent cross-contamination of surface water. Risks associated with subsurface utilities are another concern for slurry wall installation.

Alternative 4 involves the same risks as Alternative 2 with the additional risks associated with surfactant flushing implementation which includes potential exposure to the surfactant and extracted fluids from the subsurface which would require surface handling, storage, treatment, and disposal.

Alternative 5 presents similar risks to Alternative 2 but has additional risks associated with implementation of thermal treatment technology which requires use of high voltage equipment and results in volatilization of VOCs that requires treatment at the ground surface.

Alternative 6 presents similar risks like Alternative 2 but with additional risk associated with use and handling of ZVI.

By planning the construction, excavation, and transportation activities in accordance with industry and Occupational Safety and Health Administration (OSHA) codes and requirements, risks from contaminant exposure and construction operations would be controlled to acceptable levels. Dust control and sediment deposition into adjacent surface water bodies can be controlled during earthwork and construction activities. Erosion control measures would include surface grading; emplacement of silt fences; covering surfaces with straw, mulch, riprap, and/or geotextile fabrics. Following completion of all construction and excavation, disturbed areas would be regraded with clean backfill and revegetated with native grasses. Appropriate personal protective equipment (PPE) would be required for remediation workers. Overall risk can be mitigated by developing a health and safety plan in compliance with OSHA requirements, communicating the hazards to involved parties, and providing the know-how and tools to mitigate those hazards.

6. Implementability

Administratively, all the action alternatives are implementable. However, Alternative 1, No Action, would involve shutting down the groundwater extraction system, which is assumed to be administratively unacceptable to the U.S. Army and to the regulatory agencies.

The action alternatives for groundwater are all technically implementable with varying degrees of difficulty.

A potential phased reactivation of existing ICTs 3 and 9 for Alternatives 2, 4, 5, and 6 should be easy to implement as the tools and skilled resources are available. Similarly, implementation of additional extraction points for Alternative 2 should not pose any difficulties to drill the wells and connect the wells to the GWTP. EISB is specified for Alternatives 2, 4, 5, and 6. EISB has been implemented at other LHAAP sites and should not pose any difficulties to implement at LHAAP-18/24. Success of EISB was determined by conducting treatability testing and bioaugmentation at the laboratory scale. Treatability testing at the bench-scale and pilot-scale would also be required for surfactant remediation to select and optimize surfactant dose and provide proof of concept for Alternative 4 (i.e., loss of control for DNAPL migration, generation of adverse

chemicals, and penetration effectiveness in low permeability zones). Thermal treatment (Alternative 5) does not require treatability testing and its implementability hinges on the availability of power to supply the electrodes with sufficient power to heat the saturated soils. Considering that power reliability has been a concern at the GWTP, this would be an important design consideration for this technology. Implementation of ZVI for Alternative 6 faces similar implementability considerations such as EISB implementation.

Alternative 3 has two significant implementation issues: 1) the slurry wall would need to key into the confining layer for the Shallow Zone, and 2) any significant discontinuities in the confining layer would need to be addressed. To mitigate these potential containment gaps, hydraulic control throughout the system would be achieved with the GWTP. For Alternative 2, 4, 5, and 6 soil excavation would also require coordination between excavation, sampling, transportation and disposal. However, because the volumes are not large, resources are readily available to implement this component of the remedy.

7. Cost

Cost estimates are used in the CERCLA FS process to eliminate those remedial alternatives that are significantly more expensive than competing alternatives without offering commensurate increases in performance or overall protection of human health or the environment. The cost estimates developed are preliminary estimates with an intended accuracy range of +50 to –30 percent. Final costs will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final scope, final schedule, final engineering design, and other variables.

The costs include both capital costs (including fixed-price remedial construction) and long-term O&M costs (post-remediation). Overall 30-year present value costs are developed for each alternative assuming a discount rate of 3.0 percent. Some alternatives have extensive capital costs but could result in a serious reduction in the alternative lifecycle to achieve the RAOs (e.g., less than 30 years). Other alternatives that do not rely on intensive upfront remediation technologies have a very long remediation lifecycle (i.e., well beyond 30 years) that would outweigh the alternatives with high capital cost. Because cost determination was limited to 30 years per CERCLA requirements, the alternatives with high capital costs (e.g., Alternatives 5 and 6) appear to be as or more expensive on a 30-year basis than alternatives with low capital costs but long lifecycle duration (e.g., Alternatives 2 and 3). The costs for Alternatives 2 and 3 would be substantially higher than the 30 year estimates since these alternatives are estimated to need to be implemented for several hundred years to achieve RAOs.

The progression of total present value costs from the least expensive alternative to the most expensive alternative is as follows: Alternative 1, Alternative 3, Alternative 4, Alternative 5, Alternative 2, and Alternative 6. There are no costs associated with Alternative 1 because no remedial activities would be conducted. Alternative 6 has highest capital costs due to the high cost of ZVI, but lower O&M costs than all other alternatives with the exception of Alternatives 3 and 5. Alternative 5 has an O&M cost over 20 years after which the GWTP and extraction would be shut down. Alternative 5 has a higher capital cost associated with thermal treatment compared to Alternatives 2, 3, and 4. Alternatives 2, 3, and 4 have the lowest

capital costs of the active remedial alternatives, with Alternative 3 having the lowest capital cost associated with slurry wall construction and lowest O&M cost due to the greater cost reductions in O&M associated with reduction in GWTP operation and reduction in monitoring costs. Alternatives 2, 4, and 6 have the highest O&M costs of all the alternatives because it is assumed that GWTP operations would continue for 30 years with no reduction in extraction rates. Alternative 2 would also require implementation well beyond 30 years.

8. State/Support Agency Acceptance

The USEPA and TCEQ reviewed the Proposed Plan. Comments received from the USEPA and TCEQ during the Proposed Plan development have been incorporated. Both agencies concur with the preferred alternative.

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described and addressed in the Record of Decision (ROD) for the site.

SUMMARY OF THE PREFERRED ALTERNATIVE

Alternative 5 – enhanced groundwater extraction and treatment, LUCs, EISB inside and outside containment area and in Wilcox formation, unsaturated soil excavation and off-site disposal, thermal DNAPL removal (see **Figure 6**) is the preferred alternative for LHAAP-18/24 and is consistent with the intended future use of the site as a national wildlife refuge. This alternative would achieve the RAOs for the site through the following major components:

- Continued use of the existing groundwater extraction system with enhancements (including a potentially phased reactivation of two existing ICTs [ICT 3 and 9]) until COC concentrations are low enough that MNA can address remaining contamination within the containment area.
- Continued operation of the current or potentially a new GWTP, including contingency use of advanced oxidation process for treatment of 1,4-dioxane that would not require an Explanation of Significant Differences (ESD).
- Excavation of unsaturated soil exceeding groundwater protection-industrial MSC (GWP-Ind). The estimated cost to excavate soil beneath the UEP is included in this alternative and could be implemented in the future (e.g., depending on the results of the Five-Year Review of the groundwater remedy).
- Implementation of EISB of shallow zone groundwater outside the containment area at several locations; in the Wilcox formation at three or more locations, and inside the containment at five or more locations or as needed.
- Implementation of thermal desorption to remove DNAPL in two distinct areas inside the containment area at the site.
- MNA for both shallow and intermediate zone groundwater for areas outside the influence of the treatment areas and for areas inside the influence of the treatment areas (after evaluation of EISB) to reduce contaminant levels to cleanup levels and confirm the contaminated groundwater remains localized with minimal migration.
- Maintenance of existing cap over the former UEP.

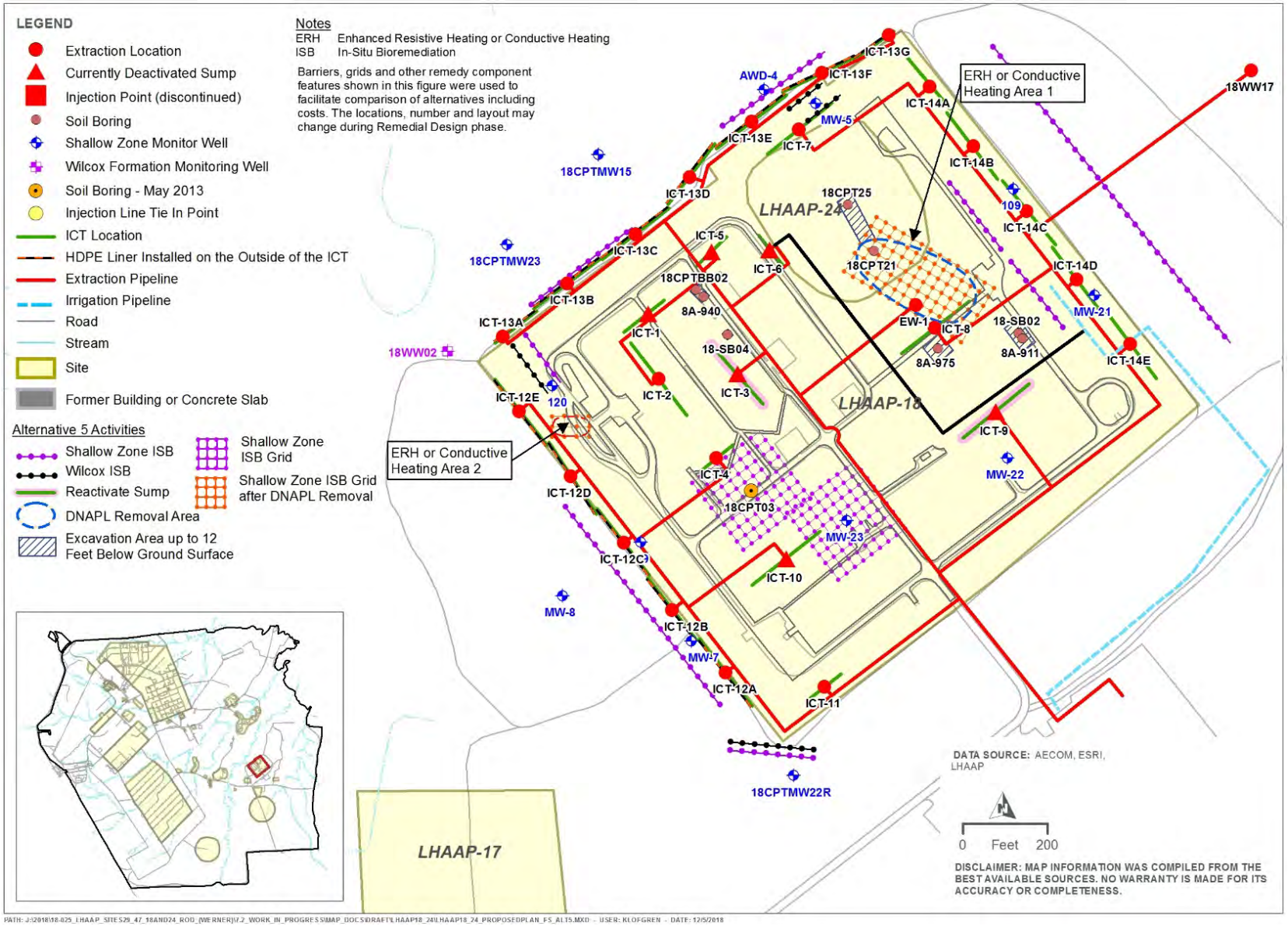

Figure 6. LHAAP-18/24 Preferred Alternative 5

- Long-term LUCs for the Shallow Zone and Wilcox Formation aquifers that will ensure protection of human health by preventing exposure until levels that allow for unlimited use and unlimited exposure have been attained.

Long-term monitoring and reporting would continue until the cleanup levels are achieved.

The thermal treatment using either ERH or conductive heating will remove TCE, MC, and other VOCs in high concentration areas, where DNAPL may exist. The decision to use either ERH or conductive heating will be made during the remedial design phase.

Based on information currently available, the U.S. Army believes the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the CERCLA §121(b) requirement used to evaluate remedial alternatives. The preferred alternative would: 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost-effective; 4) utilize a permanent solution; and 5) utilize an active treatment as a principal element. The selected remedy addresses the statutory preference for treatment to the maximum extent possible.

The U.S. Army intends to present details of the remediation in the RD for LHAAP-18/24.

The remedy selected in the ROD may change from the preferred alternative presented here, based on public comment.

Notification that the site is suitable for nonresidential use will accompany all transfer documents and will be recorded in the Harrison County Courthouse. CERCLA Five-Year Reviews will be performed to determine whether the remedy remains protective of human health and the environment.

COMMUNITY PARTICIPATION

The U.S. Army, USEPA, and TCEQ provide information regarding LHAAP-18/24 through public meetings, the Administrative Record file for the facility, and announcements published in the Shreveport Times and Marshall News Messenger newspapers. The U.S. Army encourages comments from the public on this Proposed Plan. Comments can be submitted using the enclosed form.

The dates for the public comment period, the date, location, time of the public meeting, and the locations of the Administrative Record files are provided on the front page of this Proposed Plan. Comments received will be summarized and responses provided in the Responsiveness Summary section of the ROD. Any significant changes to the Proposed Plan, as presented in this document, will also be identified and explained in the ROD.

CITED REFERENCE DOCUMENTS FOR LHAAP-18/24

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AECOM, 2017. *Final Revised Feasibility Study for LHAAP-18/24, Burning Ground No. 3 and Unlined Evaporation Pond, Longhorn Army Ammunition Plant, Karnack, Texas*, January.

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Texas Commission on Environmental Quality (TCEQ), 2006, *Updated Examples of Standard No. 2, Appendix II, Medium-Specific Concentrations*, March 21, 2006.

GENERAL REFERENCE DOCUMENT LIST FOR LHAAP-18/24

AECOM, 2013. *Final Post-Screening Investigation Report for LHAAP-18/24, Burning Ground No. 3 and Evaporation Pond, Longhorn Army Ammunition Plant, Karnack, Texas*, December.

AECOM, 2016. *1,4-Dioxane Groundwater Sampling Methodology and Analytical Results for LHAAP-18/24 at Longhorn Army Ammunition Plant, Karnack, Texas*, February.

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Shaw, 2007. *Final Installation-Wide Baseline Ecological Risk Assessment, Longhorn Army Ammunition Plant, Karnack, Texas*, Houston, Texas, Volume I: Step 3 Report, January, and Volume II: Steps 4 through 8, November.

U.S. Army Corps of Engineers (USACE), 1989. *Phase I RCRA Facility Investigation. (RFI), Active Burning Ground and Unlined Evaporation Pond, Longhorn Army Ammunition Plant, Marshall, Texas*, July.

USACE, 1993. *Data Summary Report of Investigations Results from 1976 through 1992 for Burning Ground 3 and Unlined Evaporation Pond*, May.

GLOSSARY OF TERMS

Administrative Record—The body of reports, official correspondence, and other documents that establish the official record of the analysis, cleanup, and final closure of a CERCLA site.

ARARs—Applicable or relevant and appropriate requirements. Refers to the federal and state requirements that a selected remedy will attain.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)—This law authorizes the Federal Government to respond directly to releases (or threatened releases) of hazardous substances that may be a danger to public health, welfare, or the environment. The U.S. Army currently has the lead responsibility for these activities.

Dense Non-Aqueous Phase Liquid (DNAPL)—A liquid that is both denser than water and is immiscible in or does not dissolve in water.

Enhanced In-situ Bioremediation (EISB)—EISB of chlorinated solvents in groundwater involves the input of an organic carbon source, nutrients, electron acceptors, and/or microbial cultures to stimulate degradation.

Environmental Media—Major environmental categories that surrounds or contact humans, animals, plants, and other organisms (e.g., surface water, ground water, soil or air) and through which chemicals or pollutants move.

Electrical Resistance Heating (ERH)—An intensive in situ environmental remediation method that uses the flow of alternating current electricity to heat soil and groundwater and evaporate contaminants.

Exposure—Contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin, lung, digestive tract, etc.) and available for absorption.

Feasibility Study (FS)—The process used for the development, screening, and detailed evaluation of alternative remedial actions.

Groundwater—Underground water that fills pores in soil or openings in rocks to the point of saturation.

Hazard Index—The hazard index is the sum of the hazard quotients for all chemicals to which an individual is exposed. A hazard index value of 1.0 or less indicates that no adverse non-cancer human health effects are expected to occur. Each hazard quotient is a comparison of an estimated chemical intake (dose) with a reference dose level below which adverse health effects are unlikely. Each hazard quotient is expressed as the ratio of the estimated intake (numerator) to the reference dose (denominator). The value is used to evaluate the potential for non-cancer health effects, such as organ damage, from chemical exposures.

In-Situ Thermal Desorption (ISTD)—An intensive thermally enhanced environmental remediation technology that uses conductance or resistance heating elements to directly transfer heat to environmental media to increase the volatility of contaminants such that they can be removed from the solid matrix. The volatilized contaminants are then either collected or thermally destroyed.

Land Use Control (LUC)—Administrative and legal controls or engineered and physical barriers to restrict land use that are put in place to minimize the potential for exposure to contamination and/or protect the integrity of a response action.

Maximum Contaminant Level (MCL)—The MCL is based on the National Primary Drinking Water Standard. The TCEQ has adopted MCLs at the regulatory cleanup level for both industrial and residential uses. Any detected compound in the groundwater samples with an MCL was evaluated by comparing it to its associated MCL.

Monitored Natural Attenuation—The process by which a compound is reduced in concentration over time, through absorption, adsorption, degradation, dilution, and/or transformation.

Proposed Plan—A report for public comment highlighting the key factors that form the basis for the selection of the preferred remediation alternative.

Record of Decision (ROD)—A public document that explains the cleanup method that will be used at a Superfund site, based on USEPA studies, public comments, and community concerns.

Remedial Action—The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Action Objectives (RAOs)—RAOs are established to protect human health and the environment while also meeting ARARs. The identification of RAOs must consider the environmental impacts at the site and the receptors that are affected.

Remedial Design (RD)—The phase of the CERCLA process that follows the selection of a remedial action and includes development of technical specifications and engineering drawings and other requirements for implementing cleanup remedies and technologies.

Remedial Investigation (RI)—An in-depth study designed to gather data needed to determine the nature and extent of contamination at a CERCLA site.

Risk Assessment—An analysis of the potential adverse health effects (current and future) caused by hazardous substances at a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action). The assessment contributes to decisions regarding appropriate response alternatives.

Superfund—The common name used for CERCLA; also referred to as the Trust Fund. The Superfund Program was established to help fund cleanup of hazardous waste sites. It also allows legal action to force those responsible for sites to clean them up.

Thermal Conduction Heating (TCH)—An in-situ thermal desorption remediation process whereby heat is applied to subsurface soils and groundwater through an array of vertical or horizontal heater wells placed in the subsurface that heat the impacted area to temperatures that volatize the compounds of concern.

ACRONYMS

ACD	Air Curtain Destructor
ARARs	applicable or relevant and appropriate requirements
BHHRA	Baseline Human Health Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
DCE	dichloroethylene
DNAPL	dense non-aqueous phase liquid
ECP	environmental condition of property
EISB	enhanced in-situ bioremediation
ERH	electrical resistance heating
ESD	Explanation of Significant Differences
FFA	Federal Facility Agreement
FS	Feasibility Study
GWP-Ind	soil MSC for industrial use based on groundwater protection
$^{GW}GW_{ing}$	PCL for residential groundwater use
GWTP	groundwater treatment plant
HI	hazard index
ICT	interceptor-collection trench
ISTD	in-situ thermal desorption
IRA	Interim Remedial Action
LHAAP	Longhorn Army Ammunition Plant
LUCs	land use controls
MC	methylene chloride
MCL	maximum contaminant level
µg/L	micrograms per liter
MNA	monitored natural attenuation
MSC	medium-specific concentration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethylene
PCL	protective concentration level
PPE	personal protective equipment
PSI	Post-Screening Investigation
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
TCA	trichloroethane
TCE	trichloroethylene
TCEQ	Texas Commission on Environmental Quality
TCH	thermal conduction heating
TRRP	Texas Risk Reduction Program
UEP	Unlined Evaporation Pond
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
ZVI	zero-valent iron

USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for LHAAP-18/24 is important to the U.S. Army. Comments provided by the public are valuable in helping the U.S. Army select a final remedy for these sites.

You may use the space below to write your comments, then fold and mail to Dr. Rose M. Zeiler, P.O. Box 220, Ratcliff, Arkansas 72951. Comments must be postmarked by May 2, 2019. If you have questions about the comment period, please contact Dr. Rose M. Zeiler directly at (479) 635-0110. Those with electronic communications capabilities may submit their comments to the U.S. Army via Internet at the following e-mail address: rose.m.zeiler.civ@mail.mil

LONGHORN ARMY AMMUNITION PLANT

Army Cleanup Program

Installation Action Plan

February 26, 2019

CONTENTS

ACRONYMS

Acronym	Definition
AEDB-R	Army Environmental Database - Restoration
AST	Aboveground Storage Tank
CAP	Corrective Action Plan
CC	Compliance-related Cleanup
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
DD	Decision Document
EE/CA	Engineering Evaluation and Cost Analysis
ENV	Environmental
FS	Feasibility Study
FY	fiscal year
GWTP	Groundwater Treatment Plant
HQAES	Headquarters Army Environmental System
IR	Installation Restoration
IRA	Interim Remedial Action
LHAAP	Longhorn Army Ammunition Plant
LTM	Long-Term Management
LUC	Land Use Control
mm	Millimeter
MNA	Monitored Natural Attenuation
MR	Munitions Response
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MSC	Medium-Specific Concentrations
NFA	No Further Action
PBA	Performance-Based Acquisition
PBC	Performance-Based Contract
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene

Acronym	Definition
PP	Proposed Plan
ppm	parts per million
PSI	Post-Screening Investigation
RA	Remedial Action
RA(C)	Remedial Action (Construction)
RAB	Restoration Advisory Board
RC	Response Complete
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RIP	Remedy-In-Place
ROD	Record of Decision
RRSE	Relative Risk Site Evaluation
S&R	Supervision and Review
SI	Site Inspection
SVOC	Semi-Volatile Organic Compound
TAPP	Technical Assistance for Public Participation
TCE	Trichloroethylene
TNT	Trinitrotoluene
TRC	Technical Review Committee
UEP	Unlined Evaporation Pond
USEPA	US Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WBS	Work Breakdown Structure

PHASE TRANSLATION TABLE

HQAES Phase ID	CERCLA Phase	RCRA Phase	RCRA UST Phase
.01	Preliminary Assessment (PA)	RCRA Facility Assessment (RFA)	Initial Site Characterization (ISC)
.02	Site Inspection (SI)	Confirmation Sampling (CS)	Investigation (INV)
.03	Remedial Investigation/ Feasibility Study (RI/FS)	RCRA Facility Investigation/Corrective Measures Study (RFI/CMS)	Corrective Action Plan (CAP)
.04	Remedial Design (RD)	Design (DES)	Design (DES)
.05	Interim Remedial Action (IRA)	Interim Measure (IM)	Interim Remedial Action (IRA)
.06	Remedial Action Construction) (RA(C))	Corrective Measures Implementation (CMI(C))	Implementation (Construction) (IMP(C))
.07	Remedial Action (Operation) (RA(O))	Corrective Measures Implementation (Operation) (CMI(O))	Implementation (Operations) (IMP(O))
.08	Long-Term Management (LTM)	Long-Term Management (LTM)	Long-Term Management (LTM)

SITE ALIAS LIST

WBS Element	AEDB-R Reference	Site Alias
48315.1001	LHAAP-001_INERT BURNING GROUNDS (SWMU 1)	LHAAP-001
48315.1002	LHAAP-002_VACCUM TRUCK OVERNITE PARKING	LHAAP-002
48315.1003	LHAAP-003_BUILDING 722-PAINT SHOP	LHAAP-003
48315.1004	LHAAP-004_LHAAP PILOT WASTEWATER TREATME	LHAAP-004
48315.1006	LHAAP-006_BUILDING 54F SOLVENT	LHAAP-006
48315.1007	LHAAP-007_BUILDING 50G DRUM PROCESSING	LHAAP-007
48315.1008	LHAAP-008_SEWAGE TREATMENT PLANT	LHAAP-008
48315.1010	LHAAP-011_SUS TNT BURIAL SITE AT AVE P&Q	LHAAP-011
48315.1011	LHAAP-012_ACTIVE LANDFILL (SWMU 12)	LHAAP-012
48315.1015	LHAAP-016_OLD LANDFILL (SWMU 16)	LHAAP-016
48315.1016	LHAAP-017_NO 2 FLASHING AREA BRN GROUND(	LHAAP-017
48315.1017	LHAAP-018_BURNING GROUND/WASHOUT POND(SW	LHAAP-018
48315.1018	LHAAP-019_CONSTRUCTION MATERIALS LANDFIL	LHAAP-019
48315.1020	LHAAP-024_FORMER UNLINED EVAP POND (SWMU	LHAAP-024
48315.1022	LHAAP-029_FORMER TNT PRODUCTION AREA(SWM	LHAAP-029
48315.1025	LHAAP-035_SUMPS (145) VARIOUS	LHAAP-035
48315.1026	LHAAP-036_EXPLOSIVE WASTE PADS (27)	LHAAP-036
48315.1027	LHAAP-037_CHEMICAL LABORATORY WASTE PAD	LHAAP-037
48315.1029	LHAAP-045_MAGAZINE AREA	LHAAP-045
48315.1030	LHAAP-050_FORMER WASTE DISPOSAL FACILITY	LHAAP-050
48315.1031	LHAAP-051_PHOTOGRAPHIC LABORATORY/BLDG #	LHAAP-051
48315.1032	LHAAP-052_MAGAZINE AREA WASHOUT	LHAAP-052
48315.1035	LHAAP-055_SEPTIC TANK (10)	LHAAP-055
48315.1037	LHAAP-058_MAINTENANCE COMPLEX	LHAAP-058
48315.1038	LHAAP-060_FORMER STORAGE BUILDING #411 &	LHAAP-060
48315.1040	LHAAP-063_BURIAL PITS	LHAAP-063
48315.1041	LHAAP-064_TRANSFORMER STORAGE	LHAAP-064
48315.1042	LHAAP-066_TRANSFORMER AT BLDG 401	LHAAP-066
48315.1043	LHAAP-067_ABOVE GROUND STORAGE TANK	LHAAP-067

WBS Element	AEDB-R Reference	Site Alias
48315.1044	LHAAP-068_MOBILE STORAGE TANK PARKING AR	LHAAP-068
48315.1045	LHAAP-069_SERVICE STATION UST'S	LHAAP-069
48315.1046	LHAAP-070_LOADING DOCK-MAGAZINE AREA	LHAAP-070
48315.1047	LHAAP-071_OIL SPILL, BLDG 813	LHAAP-071
48315.1048	LHAAP-001-R-01_SOUTH TEST AREA / BOMB TE	LHAAP-001-R-01
48315.1050	LHAAP-003-R-01_GROUND SIGNAL TEST AREA	LHAAP-003-R-01
48315.1052	LHAAP-004-R-01_PISTOL RANGE	LHAAP-004-R-01
48315.1053	LHAAP-046_PLANT 2 AREA	LHAAP-046
48315.1054	LHAAP-047_PLANT 3 AREA	LHAAP-047
48315.1055	LHAAP-056_VEHICLE WASH RACK AND O/W SEP	LHAAP-056
48315.1056	LHAAP-049_FORMER ACID STORAGE AREA	LHAAP-049
48315.1057	LHAAP-059_BUILDING 725	LHAAP-059
48315.1058	LHAAP-065_BUILDING 209	LHAAP-065

LONGHORN ARMY AMMUNITION PLANT

INSTALLATION RESTORATION PROGRAM SITES

LHAAP-001_INERT BURNING GROUNDS (SWMU 1)

WBS Element: 48315.1001

Alias: LHAAP-001

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 1/31/1998

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	6/30/1984
SI	6/30/1979	6/30/1984
RI/FS	8/31/1990	1/31/1998
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

The inert burning ground was used from the burning of trash, ashes, scrap lumber, and waste from burned trinitrotoluene (TNT). The site was used during the 1950s to burn photoflash powder and other discarded materials. A no action record of decision (ROD) was signed by the US Environmental Protection Agency (USEPA) in February 1998; the site is closed and suitable for non-residential use. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037(LHAAP-058). A finite period of 30 years is used where long-term management (LTM) is expected to continue. Cleanup/Exit Strategy LTM will continue.

LHAAP-002_VACCUM TRUCK OVERNITE PARKING

WBS Element: 48315.1002

Alias: LHAAP-002

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 7/15/2010

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	- -	- -
RI/FS	1/15/2009	7/15/2010
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-002 was a parking lot for trucks that were used to pump out various sumps around Longhorn Army Ammunition Plant (LHAAP). It was in use beginning approximately in 1942 through 1997. A no action decision document (DD) was finalized in 2010. A notification (not a remedy or land use control (LUC)) has been filed in Harrison County, Texas (TX) stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. Five-year review costs are captured under 48315.1037 (LHAAP-058) five-year review costs because this site falls within the boundary of LHAAP-35A(58). Cleanup/Exit Strategy LTM will continue.

LHAAP-003_BUILDING 722-PAINT SHOP

WBS Element: 48315.1003

Alias: LHAAP-003

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 9/15/2019

RC Date: 10/15/2019

RC Reason: All Required Cleanup(s) Completed

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	10/15/2007	9/15/2009
RI/FS	9/15/2009	1/15/2017
RD	2/15/2014	4/15/2017
IRA	- -	- -
RA(C)	1/15/2019	9/15/2019
RA(O)	- -	- -
LTM	- -	- -

Site Narrative

LHAAP-03 was a waste collection site outside of the paint shop at Building 722-P. Building 722-P was used for paint spraying and polyurethane spray coating of various items. Heavy metal-based primers, other waste solvents and contaminated rags were collected in a 55- gallon drum on a gravel pad in an open-sided shed. The site investigation report for LHAAP-03 was completed in August 2009. The site investigation identified soil contaminated with metals exceeding medium-specific concentrations (MSC). A remedial investigation (RI)/ feasibilty study (FS) was finalized to evaluate removal action alternatives for the metals-contaminated soil at LHAAP-03. The ROD is expected to be completed in 2018, with the selected remedy of soil excavation and off-site disposal, followed by the remedial design (RD) and soil removal. The groundwater for LHAAP-003 is addressed as part of the remedy for LHAAP-058. - Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) five-year reviews specific to LHAAP-03 will be implemented following completion of the soil remedy to evaluate whether the remedy remains protective of human health and the environment. – Five-year review costs for this site will be captured under 48315.1037 (LHAAP-058) five-year review costs because this site falls within the boundary of LHAAP-35A(58).

Cleanup/Exit Strategy The remedy being considered for this site is excavation and off-site disposal. - Finalization of the ROD and RD is planned for 2018, after which remedial action activities will begin in 2019. - LTM will involve five-year reviews, which will be addressed as part of the remedial action for LHAAP-35A(58). NOTE: - LTM phase status has been revised for FY18 Data Call from future to deleted due to system validation requirements. The user status will be revised to future or underway as applicable after 9/15/2019 when Remedial Action (Construction) (RA(C)) has ended.

LHAAP-004_LHAAP PILOT WASTEWATER TREATME

WBS Element: 48315.1004

Alias: LHAAP-004

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 1/15/2012

RC Date: 9/15/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	- -	- -
RI/FS	12/15/2011	1/15/2017
RD	1/15/2012	5/15/2017
IRA	8/15/2009	11/15/2011
RA(C)	4/15/2014	6/15/2019
RA(O)	1/15/2012	9/15/2048
LTM	- -	- -

Site Narrative

LHAAP-004, was a pilot wastewater treatment plant. Wastewater treatment operations began in 1984. The demolition of the former pilot wastewater treatment facility structures, tanks, and piping, and the disposal of the associated wastes were completed in the summer of 1997 as part of the Resource Conservation and Recovery Act (RCRA) closure of the plant. Under the CERCLA program, excavation of soil impacted with mercury and perchlorate at the LHAAP 04 site was completed in 2009 along the southern edge of the slab, which formerly housed storage tanks for the former pilot wastewater treatment facility. The completion report was finalized in 2011. As part of the removal action, a well was installed to sample groundwater beneath the backfilled excavation area. The results indicated that perchlorate was present in the groundwater at a concentration that exceeded the Texas Commission on Environmental Quality groundwater industrial use value for perchlorate. The FS evaluating remedial alternatives for LHAAP-04 was finalized in August 2012. The ROD was finalized in 2017. The costs for the RD were captured in FY17. The RA(C) will be completed in FY19. Remedial Action (Operation) (RA(O)) and five-year reviews will be required. A finite period of 30 years is used where RA(O) is expected to continue. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The supervision and review (S&R) costs for the site are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy The RD is expected to be completed in 2018 and remedy-in-place (RIP) is expected in 2019. Long-term RA(O) will involve monitored natural attenuation (MNA) and LUC.

LHAAP-006_BUILDING 54F SOLVENT

WBS Element: 48315.1006

Alias: LHAAP-006

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 12/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	- -	- -
RI/FS	12/15/2007	12/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-06 (Building 51-F) was a collection point for waste acids and solvents. A no further action (NFA) DD was signed in December 2008. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews is required.

LHAAP-007_BUILDING 50G DRUM PROCESSING

WBS Element: 48315.1007

Alias: LHAAP-007

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 12/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	- -	- -
RI/FS	12/15/2007	12/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-007 (Drum Processing Building 50-G) was a wash-down area for empty drums and casting equipment. The site was originally closed under RCRA in 1987. An NFA DD under CERCLA was signed in December 2008. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for nonresidential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews is required.

LHAAP-008_SEWAGE TREATMENT PLANT

WBS Element: 48315.1008

Alias: LHAAP-008

Regulatory Driver: RCRA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 11/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	- -	- -
RI/FS	2/15/2002	11/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-008 was the sewage treatment plant that operated from 1942 to 1997. The site was originally closed under RCRA in 1987. An NFA DD under CERCLA was signed in 2008. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews is required.

LHAAP-011_SUS TNT BURIAL SITE AT AVE P&Q

WBS Element: 48315.1010

Alias: LHAAP-011

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 1/31/1998

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	8/31/1990	1/31/1998
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-011, suspected TNT burial site, has been inactive since its suspected use in the 1940s. An NFA ROD was signed by the USEPA by February 1998. The site is closed and suitable for industrial use. A five-year review report in the form of a memorandum report stating the use of the site remains industrial will be required for internal Army records. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews is required.

LHAAP-012_ACTIVE LANDFILL (SWMU 12)

WBS Element: 48315.1011

Alias: LHAAP-012

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 6/30/2007

RC Date: 9/15/2100

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	8/31/1990	7/31/2006
RD	9/30/2005	6/30/2007
IRA	9/30/1995	9/30/2005
RA(C)	9/30/2005	6/30/2007
RA(O)	6/30/2007	9/15/2125
LTM	- -	- -

Site Narrative

Landfill 12 (previously called the Active Landfill), consisting of seven acres, was used for the disposal of nonhazardous industrial waste. The landfill had been used intermittently since 1963. Continuous use of the landfill began around 1978. Although the back section had been closed, the front section of the landfill continued to be used until its closure in March 1994. Site inspections (SI) conducted in 1993 concluded that an early interim remedial action (IRA) (landfill cap) was necessary to reduce further contamination to the groundwater. In 1997 the cap was completed, using treated soils from LHAAP-18 as subgrade fill. Cap maintenance started in 1998, and in 2002 the first five-year review was completed. The second five-year review was completed in 2008. The third five-year review was completed in 2013. In 2002 the RI was completed. Groundwater analysis showed that some metals, chlorides, volatile organic compounds (VOC), explosive compounds, and low levels of perchlorate were present. Surface water and sediment sample analysis showed similar contamination. Low levels of perchlorate were also detected in the soils. In three groundwater sampling rounds conducted in February 2003, February 2004, and December 2004, perchlorate was not detected with reporting limits of four micrograms per liter (ug/L) in the first two rounds, and only detected twice when a method with a lower reporting limit (0.2 ug/L) was used. Chromium in groundwater is now believed to be related to stainless steel well casings. In January 2006 the 12 wells with stainless steel casings and screen were removed. In 2006, five new wells were installed for long-term monitoring using polyvinyl chloride casing and screen. Results of subsequent groundwater sampling supported the postulation that the stainless steel casing in the monitoring wells was the source of the chromium. In 2005 the FS was finalized. The recommended final remedy is MNA with LUCs consisting of cap protective provisions and groundwater restrictions. In August 2006 sampling to support MNA began. The proposed plan (PP) addressed human and ecological risk. The ROD has been signed (July 2006), and in June 2007 the RD addendum was signed. The surrounding sediment and surface water were evaluated as part of the the plant wide ecological risk assessment and no chemicals of concern were identified. Post- Performance-Based Acquisition (PBA) (FY2017 and out-years) actions will include MNA with LUC consisting of cap protective provisions and groundwater restrictions. The expected duration of RA(O) is 118 years based on the groundwater model from the RD. The first full year of RA(O)

was completed in 2008. The costs for the installation wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for this site are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy RA(O) in the form of cap maintenance, MNA, and five-year reviews.

LHAAP-016_OLD LANDFILL (SWMU 16)

WBS Element: 48315.1015

Alias: LHAAP-016

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 8/31/2005

RC Date: 9/15/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	8/31/1990	1/15/2017
RD	8/31/2005	4/15/2017
IRA	10/31/1994	9/30/2005
RA(C)	8/31/2005	12/15/2018
RA(O)	8/31/2005	9/15/2048
LTM	- -	- -

Site Narrative

Landfill 16 (formally called the old landfill), consisting of about 22 acres, was originally used to dispose of products generated from the TNT wastewater treatment plant; however, a variety of waste was disposed of in the landfill until the 1980s. This waste may have included burned rocket motor casings, substandard TNT, barrels of chemicals, oil, paint, scrap iron and wood. VOCs and metals above action levels have been found in the soil, surface water and groundwater around the site. Low levels of explosive compounds were detected in the groundwater. SIs conducted in 1993 concluded that an early IRA (landfill cap) was necessary to reduce further contamination to the groundwater. The cap was completed in 1998, using treated soils from LHAAP-18 as subgrade fill. In late-1997, as part of the treatability study, eight extraction wells were installed to prevent contaminated groundwater from impacting Harrison Bayou. This system is still in operation; however, extracted water volume is low. Groundwater extracted from the Landfill 16 containment system is piped to the LHAAP-18 groundwater treatment plant (GWTP). Perchlorate was first detected in groundwater at this site in 2000. VOCs and perchlorate have been detected in the surface water of Harrison Bayou. In 2002 the RI was completed along with a five-year review. In March 2002 a final interim FS for Site 16 was issued. Under the performance-based contract (PBC), a draft FS addendum to the March 2002 interim FS was submitted in February 2007. The FS was finalized in March 2010. A preliminary MNA evaluation was completed in 2007. The second five-year review was completed in 2008. The third five-year review was completed in 2013. The PP was finalized September 2010. Quarterly surface water sampling of the Harrison Bayou area has not shown significant contamination. An environmental security technology certification program research and development project for enhanced in situ bioremediation (VOCs, perchlorate and explosives in groundwater) was started in 2003 and continued to 2008. Ecological concerns most likely will be addressed with the final remedy at this site. The ROD was finalized in 2016. The ROD includes cap maintenance, in situ bioremediation, bio barriers, MNA and LUCSs. RA(C) will be completed in 2018. Post-RA(C) actions will include groundwater monitoring and LUC RA(O). The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for this site are captured under 48315.1017

(LHAAP-018). Cleanup/Exit Strategy RA(O) in the form of MNA with maintenance of the cap and LUC and five year reviews.

LHAAP-017_NO 2 FLASHING AREA BRN GROUND(

WBS Element: 48315.1016

Alias: LHAAP-017

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 6/15/2019

RC Date: 9/15/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	8/31/1990	1/15/2017
RD	4/15/2018	10/15/2018
IRA	- -	- -
RA(C)	8/15/2018	6/15/2019
RA(O)	6/15/2019	9/15/2048
LTM	- -	- -

Site Narrative

This site (about 500 by 600 feet) was used to burn bulk TNT, photoflash powder, and reject material the production process. From 1959 until 1980 the site was operated as a burning ground. In 1959 buildings razed at Site 29 (the former TNT production area) were burned at Burning Ground No. 2/Flashing Area (LHAAP-17). This site is situated about 400-500 feet southwest of Burning Ground No. 3. In 1984 waste residues were removed and the area grassed over. VOCs and explosive compounds were found in the groundwater. Explosive compounds were found in the soil. In 2000 perchlorate was detected at this site [in groundwater at 300 parts per million (ppm), but less in soil]. In 2002 the RI was completed and a draft FS was prepared. In 2004 additional data gap studies were completed. A revised draft FS was submitted in 2009 by the PBC and the FS was finalized in 2010. The PP was finalized in May 2010.The ROD was finalized in 2016. The ROD includes soil removal, extraction and treatment of groundwater, MNA and LUCs. A post-screening investigation (PSI) will be completed in 2018. The RD will be completed in 2018 and RA(C) will be completed in FY19. A research and development project for enhanced in situ bioremediation (VOCs, perchlorate and explosives in soil and groundwater) was started in 2002 and completed in 2004. Results indicate that perchlorate contamination was reduced. An additional intermediate well was installed at the site in February 2008. Post-RA(C) actions during RA(O) will involve monitoring of MNA. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for this site are captured under 48315.1017 (LHAAP-018).

Cleanup/Exit Strategy RA(O) in the form of MNA and LUC and five-year reviews.

LHAAP-018_BURNING GROUND/WASHOUT POND(SW

WBS Element: 48315.1017

Alias: LHAAP-018

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 10/30/2021

RC Date: 9/30/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	8/31/1990	9/15/2019
RD	3/30/2020	9/30/2020
IRA	3/31/1995	9/30/2021
RA(C)	10/30/2020	9/30/2026
RA(O)	10/30/2021	9/30/2048
LTM	- -	- -

Site Narrative

This 34.5 acre site, also known as Burning Ground No. 3, began operations in 1955. It was used for the treatment, storage, and disposal of solid and liquid explosives, pyrotechnics, and combustible solvent wastes by open burning, open detonation, and burial. The unlined evaporation pond (UEP) (LHAAP-024) was constructed in 1963 within Burning Ground No. 3. Explosive compounds, VOCs, and metals were detected in the soils and groundwater. In 1998 perchlorate was detected in the groundwater. In 1986 sludge from the UEP was removed and the area was capped. Quarterly monitoring has been conducted at the site since closure of the UEP. In May 1995 an IRA ROD was signed. This IRA addressed soil and shallow groundwater contamination. In 1997, 30,000 cubic yards (cy) of soil were excavated and treated. The treated soil was used as fill in LHAAP-012 and -016. A GWTP, with approximately 5,000 feet of interception collection trenches, has been installed to control migration of contaminated groundwater. After treatment the extracted groundwater is discharged into Harrison Bayou. In 1999 perchlorate was detected at this site and a fluidized bed reactor treatment system was installed. In 2002 the RI was completed, followed by a draft FS. In September 2007 the PBC contractor began an optimization pilot study for the groundwater extraction system with a report completed in February 2009. The PSI work plan was finalized in 2013 to address site data gaps and support completion of the RI/FS. The PSI work continued into 2016 and the revised FS was completed in 2017. It is assumed that Alternative 5 from the revised FS will be the final remedy. - At this time, the RA(O) is expected to include three years of interim remedy operation until the final remedy can be implemented and 27 years of final remedy operation and five-year reviews are expected to last beyond 30 years. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The LHAAP-018 MFR includes all USACE S&R costs for LHAAP-001-R-01, 003-R-01, 004, 012, 016, 107, 018, 024, 029, 037, 046, 047, 050, 058 and 067. Cleanup/Exit Strategy The final remedy has not been selected yet for this site. - It is assumed that Alternative 5 from the revised FS will be the final remedy. - At this time, the RA(O) is expected to include three years of interim remedy operation until the final remedy can be implemented and 27 years of final remedy operation and five-year reviews are expected to last beyond 30 years. The site remedy is enhanced groundwater extraction and ex situ treatment, LUCs, enhanced in situ bioremediation inside

and outside containment area and in Wilcox, unsaturated soil excavation and off site disposal, and thermal dense non-aqueous phase liquid removal.

LHAAP-019_CONSTRUCTION MATERIALS LANDFIL

WBS Element: 48315.1018

Alias: LHAAP-019

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 1/15/2014

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	9/15/2010	1/15/2014
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2014	9/15/2048

Site Narrative

The site was originally closed under RCRA in 1987. A NFA DD under CERCLA was finalized in early 2014. A notification (not a remedy or LUC) was filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential will be required. The costs for the installation-wide five-year reviews are captured under LHAAP-058. A finite period of 30 years is used where LTM is expected to continue.

LHAAP-024_FORMER UNLINED EVAP POND (SWMU

WBS Element: 48315.1020

Alias: LHAAP-024

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 10/30/2021

RC Date: 9/30/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	5/31/1990
SI	5/31/1990	8/31/1990
RI/FS	8/31/1990	9/15/2019
RD	3/30/2020	9/30/2020
IRA	3/31/1995	9/30/2021
RA(C)	10/30/2020	9/30/2026
RA(O)	10/30/2021	9/30/2048
LTM	- -	- -

Site Narrative

This three-acre UEP was constructed in 1963 within Burning Ground No. 3. Explosive compounds, VOCs, and metals were detected in the soils and groundwater. In 1999, perchlorate was detected in the groundwater. In 1986, sludge from the UEP was removed and the area was capped. Quarterly monitoring has been conducted at the site since closure of the UEP. In May 1995, an IRA ROD was signed. This IRA addressed soil and shallow groundwater contamination. In 1997, 30,000 cy of soil were excavated and treated. The treated soil was used as fill in LHAAP-012 and LHAAP-016. A GWTP, with approximately 5,000 feet of interception collection trenches, has been installed to control migration of contaminated groundwater. After treatment, the extracted groundwater is discharged into Harrison Bayou. In 1999 perchlorate was detected at this site and in 2001 a fluidized bed reactor treatment system was installed. In 2002 the RI was completed, followed by a draft FS. In September 2007 the PBC contractor began an optimization study for the groundwater extraction system with a report on the results completed February 2009. A PSI work plan was finalized in 2013 to address site data gaps and support completion of the RI/FS. The PSI work was completed in 2016 and the revised FS was completed in 2017. It is assumed that Alternative 5 from the revised feasibility study will be the final remedy. - At this time, the RA(O) is expected to include three years of interim remedy operation until the final remedy can be implemented and 27 years of final remedy operation and five-year reviews are expected to last beyond 30 years. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). All S&R related costs for the subject site are captured under 48315.1017 (LHAAP-018).

Cleanup/Exit Strategy The final remedy has not been selected yet for this site. - It is assumed that Alternative 5 from the revised feasibility study will be the final remedy. - At this time, the RA(O) is expected to include three years of interim remedy operation until the final remedy can be implemented and 27 years of final remedy operation and five -year reviews are expected to last beyond 30 years. The site remedy is enhanced groundwater extraction and ex situ treatment, LUCs, enhanced in situ bioremediation inside and outside containment area and in Wilcox, unsaturated soil excavation and off site disposal, and thermal dense non-aqueous phase liquid removal.

LHAAP-029_FORMER TNT PRODUCTION AREA(SWM

WBS Element: 48315.1022

Alias: LHAAP-029

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 9/15/2021

RC Date: 9/15/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	8/31/1990	9/15/2019
RD	8/31/2005	6/15/2020
IRA	- -	- -
RA(C)	10/15/2020	9/15/2021
RA(O)	10/15/2021	9/15/2048
LTM	- -	- -

Site Narrative

The former TNT production area, consisting of about 85 acres, was in operation from April 1943 to August 1945 as a six-line plant, with a supporting acid plant. The plant produced 180 million kilograms of TNT throughout the period of operation. A bulk toluene storage area, servicing the TNT production area, was located adjacent to the production area. The TNT wastewater (red water) from the production of the TNT was sent through wooden pipelines to a storage tank and pump house, and then to the TNT wastewater treatment plant (LHAAP-032). Cooling water (blue water) from the production area ran through main lines and into an open ditch. In 1959, the structures, except for the foundations, were demolished and removed. Through the late-1980s a portion of the northeast corner of the site (approximately two acres) was used for the washout of Pershing 1 and 2 rocket motor casings using trichloroethylene (TCE) and methylene chloride. Explosive compounds have been detected in the soil, surface water, sediment, and groundwater samples. High concentrations of VOCs (including TCE and methylene chloride) have been detected in the groundwater with the highest concentrations in the intermediate hydrostratigraphic unit, and methylene chloride, dense non-aqueous phase liquid is suspected. In 2000 perchlorate was first detected in the soil and in the groundwater (at 88 ppm) at this site. In 2002, the RI was completed. In FY2005 field sampling for soils was conducted. In FY2006, six wells were installed and sampled. Sediment samples were also collected from waste lines and outfall ditches. A revised draft FS was submitted in 2008 and was finalized in 2010. Fieldwork to support an addendum to the RI/FS for LHAAP-29 was completed in 2013 and the RI/FS addendum was finalized in FY17. It is assumed that Alternative 4a from the feasibility study addendum will be the final remedy. At this time, the post-PBA RA(O) is expected to include MNA/LUCs and five-year reviews and is expected to last beyond 30 years. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). - S&R costs for the site are captured under 48315.1017 (LHAAP-018).

Cleanup/Exit Strategy The final remedy has not been selected yet for this site. It is assumed that Alternative 4a from the feasibility study addendum will be the final remedy. At this time, the post-PBA RA(O) is expected to include MNA/LUCs and five-year reviews and is expected to last beyond 30 years. The site remedy is excavation, in situ electrical resistivity heating, MNA and LUCs.

LHAAP-035_SUMPS (145) VARIOUS

WBS Element: 48315.1025

Alias: LHAAP-035

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 11/15/2010

RC Date: 11/15/2010

RC Reason: All Required Cleanup(s) Completed

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	1/31/1993	11/15/2010
RD	8/31/2005	11/15/2010
IRA	- -	- -
RA(C)	8/31/2005	11/15/2010
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

This site contained 125 industrial wastewater sumps. The sumps were located in different production areas within LHAAP. Many of the sumps were removed or closed in 1996. Several buildings at sites where sumps were located have a history of perchlorate use. Perchlorate contamination at these sites has been identified in the soil, surface water and groundwater. RA(C) consisted of soil removal around sumps. In 2002, the RI was completed and in late FY23 the initial perchlorate assessment was completed. Additional soil sampling, for the sumps, was completed in fall 2006. The following sites are associated with LHAAP-35 in because there were sumps at the sites; however, they are being addressed as separate sites for other environmental issues [i.e. five-year reviews, RA(O)/LTM]: LHAAP-002 LHAAP-003 LHAAP-004, LHAAP-006 LHAAP-007 LHAAP-036 LHAAP-058 LHAAP-060 LHAAP-65 LHAAP-068 (PBC) LHAAP-008 LHAAP-037 (TERC). The NFA DD was signed in November 2010. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews is required.

LHAAP-036_EXPLOSIVE WASTE PADS (27)

WBS Element: 48315.1026

Alias: LHAAP-036

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 11/15/2010

RC Reason: Other

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	6/30/1979	5/31/1987
RI/FS	1/15/1993	11/15/2010
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

This site consists of 20 waste pads made of metal roof over four by eight concrete pads. It is included in Group 4 RI/FS. Production buildings had sumps that collected wash down water. - Sumps were associated with the wash racks (waste rack sumps) where containers were cleaned and stored. - The NFA DD was signed in November 2010. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non- residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058).

Cleanup/Exit Strategy LTM in the form of five-year reviews is required.

LHAAP-037_CHEMICAL LABORATORY WASTE PAD

WBS Element: 48315.1027

Alias: LHAAP-037

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 1/15/2012

RC Date: 9/15/2049

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	- -	- -
RI/FS	3/15/2010	6/15/2010
RD	6/15/2010	8/15/2011
IRA	- -	- -
RA(C)	1/15/2012	9/15/2013
RA(O)	1/15/2012	9/15/2049
LTM	- -	- -

Site Narrative

This site is a collection point for spent solvents from the quality assurance lab. It consists of one 55-gallon drum set on a concrete pad. The site is included in the Group 4 RI/FS. The ROD was finalized in August 2010 and included MNA and LUCs for the site. The RD was finalized in August 2011. The remedial action work plan (RAWP) was finalized in 2013. RIP was achieved in September 2013. The RA(O) was on hold while a two-year bioplug demonstration was implemented at the site. The bioplug demonstration was completed at the end of 2014 and the aquifer was being monitored for return to pre-study conditions before proceeding with RA(O). MNA Study identified 39 years for RA(O) with 32 years remaining as of FY18. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for this site are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy RA(O) in the form of MNA and LUC and five year reviews will continue.

LHAAP-045_MAGAZINE AREA

WBS Element: 48315.1029

Alias: LHAAP-045

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 8/18/2004

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	3/31/2000	7/30/2004
RI/FS	8/18/2004	8/18/2004
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	10/15/2004	9/15/2048

Site Narrative

This site consists of 800 acres with 58 bunkers and two buildings used for storage of munitions. An SI conducted by US Army Center for Health, Promotion and Preventive Medicine (now known as the Public Health Command), determined perchlorate contamination. The RI was completed in September 2003. The final evaluation of LHAAP-45 surface soil analytical data was finalized in September 2004. The site received USEPA concurrence for no further environmental investigation necessary. The site is closed and suitable for industrial use. A five-year review report in the form of a memorandum report stating the use of the site remains industrial will be required for internal Army records. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-050_FORMER WASTE DISPOSAL FACILITY

WBS Element: 48315.1030

Alias: LHAAP-050

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 8/31/2005

RC Date: 9/15/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	6/30/1995	7/31/1997
RI/FS	1/31/1998	1/31/2010
RD	8/31/2005	2/28/2011
IRA	- -	- -
RA(C)	8/31/2005	9/15/2019
RA(O)	8/31/2005	9/15/2048
LTM	- -	- -

Site Narrative

This site of about one acre received wastewater from the sumps at Plants 2 and 3 from 1955 to the early-1970s. Washout of ammonium perchlorate containers was also performed on this site. VOCs and perchlorate were detected in the soil samples. VOCs, metals and perchlorate were detected in groundwater. The VOCs and perchlorates in groundwater pose an unacceptable risk. In 2004 an additional data gap sampling was completed and in February 2008 an additional shallow well was installed downgradient of this site. In 2002, the RI was completed and the FS was finalized in 2010. The ROD was finalized in 2010. The ROD includes soil removal, MNA and LUCs (groundwater use restriction) for the site. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non- residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential will be required. The RD was finalized in September 2011. The RAWP was finalized in 2013. RIP was achieved in September 2013. This site is in RA(O). The third annual RA(O) report concludes that MNA is not effective and the contingency remedy be implemented to enhance MNA. The contingency remedy will be implemented in FY19. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). S&R costs for the site are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy RA(O) in the form of MNA and LUC and five year reviews. RA(C) in the form of in situ bioremediation to be implemented in FY19. 058. S&R costs for the site are captured under LHAAP-018.

LHAAP-051_PHOTOGRAPHIC LABORATORY/BLDG

WBS Element: 48315.1031

Alias: LHAAP-051

Regulatory Driver: RCRA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 12/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	- -	- -
RI/FS	12/15/2007	12/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

Building 60B was the location for processing x-ray film. It was closed under RCRA. A NFA DD was signed in December 2008 under CERCLA. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-052_MAGAZINE AREA WASHOUT

WBS Element: 48315.1032

Alias: LHAAP-052

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 9/15/2015

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	6/30/1995	4/30/1998
RI/FS	6/15/1997	9/15/2015
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	9/15/2015	9/15/2048

Site Narrative

A standpipe near the intersection of Avenue E and 19th was used to wash out trucks used for transport of TNT. An NFA DD was finalized in September 2015. Limited monitoring in the form of certification of proper land use every five years is required for this site. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-055_SEPTIC TANK (10)

WBS Element: 48315.1035

Alias: LHAAP-055

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 12/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	- -	- -
RI/FS	8/15/1990	12/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-055 consisted of ten septic tanks that served outlying areas of the installation that could not be connected to the plant sanitary sewer system. This site was closed under RCRA guidelines. An NFA DD was signed in December 2008 under CERCLA. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-058_MAINTENANCE COMPLEX

WBS Element: 48315.1037

Alias: LHAAP-058

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 9/15/2011

RC Date: 9/15/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	2/28/1995	6/30/1995
RI/FS	6/15/2010	9/15/2010
RD	6/15/2011	9/15/2011
IRA	- -	- -
RA(C)	9/15/2011	9/15/2013
RA(O)	9/15/2011	9/15/2048
LTM	- -	- -

Site Narrative

LHAAP-35A(58), also known as the shops area, was used to provide plant-operated laundry, automotive, woodworking, metalworking, painting, refrigeration, and electrical services. VOCs were detected in groundwater. The ROD was finalized in 2010 and includes in situ bioremediation for the eastern plume and MNA and LUCs (groundwater use restriction) for both the eastern and western groundwater plume for the site. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential will be required. Five-year review costs for LHAAP-002, 003, 056, 059, 060, 065, 068, and 069 are captured with LHAAP-35A(58) because these sites fall within the boundary of LHAAP-35A(58). The RD was finalized in September 2011. The RAWP was finalized in 2013. RIP was achieved in September 2013. A contingency remedy of in-situ bioremediation was implemented in the western plume in 2018. This site is in RA(O). The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for this site are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy RA(O) in the form of MNA and LUC and five-year reviews.

LHAAP-060_FORMER STORAGE BUILDING #411 &

WBS Element: 48315.1038

Alias: LHAAP-060

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 12/15/2008

RC Reason: Other

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	6/30/1995	7/31/1997
RI/FS	1/31/1998	12/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

This site consists of two buildings formerly used for storage of pesticides and herbicides. It is included in Group 4 for RD/RA efforts. An NFA DD was signed in December 2008. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. Five-year review costs are captured under 48315.1037 (LHAAP-058) because this site falls within the boundary of LHAAP-35A(58). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-063_BURIAL PITS

WBS Element: 48315.1040

Alias: LHAAP-063

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 9/15/2015

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	6/30/1995	4/30/1998
RI/FS	4/15/1998	9/15/2015
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	9/15/2015	9/15/2048

Site Narrative

LHAAP-063 was used in late-1950s for the detonation of Plant 3 reject material of unknown composition. An NFA DD was finalized in September 2015. Limited monitoring in the form of certification of proper land use every five years is required for this site. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-064_TRANSFORMER STORAGE

WBS Element: 48315.1041

Alias: LHAAP-064

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 12/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	2/28/1995	6/30/1995
RI/FS	6/15/1995	12/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-064 was used for storage of non- polychlorinated biphenyl (PCB) transformers. NFA was required and an NFA DD was signed in December 2008. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-066_TRANSFORMER AT BLDG 401

WBS Element: 48315.1042

Alias: LHAAP-066

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 12/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	2/28/1995	6/30/1995
RI/FS	6/15/1995	12/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

A transformer at Building 401 dripped oil for approximately one year. The transformer did not contain PCBs, so NFA was required. An NFA DD was signed in December 2008. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non- residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews is required.

LHAAP-067_ABOVE GROUND STORAGE TANK

WBS Element: 48315.1043

Alias: LHAAP-067

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 1/15/2012

RC Date: 9/15/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	9/30/1998	6/30/1999
RI/FS	10/31/2001	6/15/2010
RD	5/15/2011	8/15/2011
IRA	- -	- -
RA(C)	1/15/2012	4/15/2013
RA(O)	1/15/2012	9/15/2048
LTM	- -	- -

Site Narrative

This site consisted of seven aboveground storage tanks (AST) containing Number 2 fuel oil, kerosene or solvents. The ASTs had earthen dikes sufficient to contain a potential spill. Motor fuel tanks were registered with the state and have been removed. Central Creek runs to the south of this site. In 2001 VOCs (TCE, 1,1-dichloroethene, 1 ,2-dichloroethane, 1,1,2-trichloroethane) were detected in the groundwater. The data indicates that the impact is limited. In 2002 the RI was completed and in 2004 additional sampling was conducted, with the final FS completed in August 2005. The ROD was finalized in August 2010 and included MNA and LUCs (groundwater use restriction) for the site. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non- residential will be required. The RD was finalized in August 2011. The RAWP was finalized in 2013 and RIP was achieved in April 2013. This site is in RA(O). The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for this site are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy RA(O) in the form of MNA and LUC and five year reviews will continue.

LHAAP-068_MOBILE STORAGE TANK PARKING AR

WBS Element: 48315.1044

Alias: LHAAP-068

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 12/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	- -	- -
RI/FS	8/15/1990	12/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-068 is located in the maintenance shops and power area near the service station. LHAAP-068 consisted of two mobile 600-gallon storage tanks on trucks. The mobile storage tanks contained No. 2 diesel and gasoline fuel. One PCB (Aroclor 1254) was measured above the applicable MSC in one sample. Soil from this location was selected for leachability testing and analysis of the test leachate for PCBs. Concentrations of Aroclor 1254 in the leachate meets the requirements of 30 Texas Administrative Code 335.559(g)(2)(B) for site closure and PCBs are of no further concern. This site was corrected under RCRA guidelines in 1993. An NFA DD was signed in December 2008. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non- residential is required. Five-year review costs are captured under 48315.1037 (LHAAP-058) five-year review costs because this site falls within the boundary of LHAAP-35A(58). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue. .

LHAAP-069_SERVICE STATION UST'S

WBS Element: 48315.1045

Alias: LHAAP-069

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 1/15/2014

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/31/1990	8/31/1990
SI	- -	- -
RI/FS	8/15/1990	1/15/2014
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2014	9/15/2048

Site Narrative

LHAAP-069 (Service Station Underground Storage Tanks) consisted of six gasoline underground storage tanks that were leak tested in 1989 and determined to be leaking. The tanks were replaced in 1993 and the site has been remediated. LHAAP-069 was corrected under RCRA guidelines in 1993. The contaminant of concern was petroleum, oil, and lubricants. Petroleum product and its constituents is not a CERCLA hazardous substance. A NFA DD was finalized in early 2014. A notification has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. Because LHAAP-069 is entirely contained within the LHAAP-35A(58) land use control boundary, this requirement is being met under LHAAP-35A(58). A five-year review report in the form of a letter stating the use of the site remains non-residential will be required. Five-year review costs are captured under 48315.1037 (LHAAP-058) five-year review costs because this site falls within the boundary of LHAAP-35A(58). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-070_LOADING DOCK-MAGAZINE AREA

WBS Element: 48315.1046

Alias: LHAAP-070

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 9/15/1995

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	2/28/1995	6/30/1995
RI/FS	6/15/1995	9/15/1995
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	9/15/2015	9/15/2048

Site Narrative

LHAAP-070 (Loading Dock-Magazine Area) is located in the magazine area LHAAP-045. There was a report of spill of boxes of TNT at LHAAP-070; however, SIs revealed no visual evidence of TNT contamination. NFA is required. A DD was finalized in September 2015. Limited monitoring in the form of certification of proper land use every five years is required for this site. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-071_OIL SPILL, BLDG 813

WBS Element: 48315.1047

Alias: LHAAP-071

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 9/15/2015

RC Reason: All Required Cleanup(s) Completed

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	6/30/1979	5/31/1987
SI	2/28/1995	6/30/1995
RI/FS	6/15/1995	9/15/2015
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	9/15/2015	9/15/2048

Site Narrative

LHAAP-071 (Building 813), though unrelated to the TNT Waste Disposal, is located in the TNT Waste Disposal Plant. An oil tank spill occurred at Building (Bldg) 813 in 1978. The spill was contained before it could reach Central Creek. An NFA DD was finalized in September 2015. Limited monitoring in the form of certification of proper land use every five years is required for this site. The costs for the installation-wide five-year reviews would be captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-046_PLANT 2 AREA

WBS Element: 48315.1053

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 1/15/2012

RC Date: 9/15/2048

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	1/15/2002	1/15/2002
SI	- -	- -
RI/FS	6/15/2010	9/15/2010
RD	6/15/2011	9/15/2011
IRA	- -	- -
RA(C)	1/15/2012	4/15/2013
RA(O)	1/15/2012	9/15/2048
LTM	- -	- -

Site Narrative

LHAAP-046, also known as Plant 2, had facilities for production of JB-2 propellant fuel from 1944-1945 and was used to produce pyrotechnic ammunition, such as photoflash bombs, simulators, hand signals, and tracers for 40 millimeter (mm) ammo from 1952-1956. Plant 2 was reactivated to produce pyrotechnic and illuminating devices from 1964 to 1997. Site investigations determined that groundwater was contaminated with VOCs. The ROD was finalized in September 2010 and includes MNA and LUCs for the site. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential will be required. The RD was finalized in September 2011. The RAWP was finalized in 2013 and RIP was achieved in April 2013. This site is in RA(O). The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for the site are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy RA(O) in the form of MNA and LUC and five-year reviews will continue.

LHAAP-047_PLANT 3 AREA

WBS Element: 48315.1054

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 9/30/2021

RC Date: 9/30/2051

RC Reason: Not assigned

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	1/1/1980	5/15/1987
SI	- -	- -
RI/FS	1/15/2012	9/15/2018
RD	3/30/2020	9/30/2020
IRA	- -	- -
RA(C)	10/15/2020	9/30/2021
RA(O)	10/30/2021	9/30/2051
LTM	- -	- -

Site Narrative

LHAAP-47, also known as Plant 3, was used from 1954 to the early-1980s to produce rocket motors. Some of the rocket motor facilities converted to produce pyrotechnic and illumination devices, and continued this operation until 1997. Site investigations determined that groundwater was contaminated with VOCs, perchlorate, and metals and a soil source for perchlorate was identified. The FS evaluating remedial alternatives for LHAAP-47 was finalized in July 2011. The final ROD is delayed until a post-screening investigation is completed. It is too early in the remedy selection process to establish the final remedy components for the site. For this reason the site is reported as a zero cost site until the PP and ROD select the final remedy. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). S&R costs are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy The final remedy has not been selected yet for this site. It is assumed that the final remedy and associated costs will be similar to site LHAAP-16. - At this time, the post-PBA RA(O) is expected to include MNA/LUCs and five-year reviews and is expected to last beyond 30 years. The remedy for this site is in situ bioremediation, biobarriers, soil excavation, and MNA.

LHAAP-056_VEHICLE WASH RACK AND O/W SEP

WBS Element: 48315.1055

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 1/15/2014

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	4/15/1993	10/15/2008
SI	- -	- -
RI/FS	1/15/2012	1/15/2014
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2014	9/15/2048

Site Narrative

This site consisted of a concrete washrack sloped to drain, connected to an oil/water separator. The site had a permitted discharge to a drainage ditch. The site is located within the shop area. The sump on this site was investigated under LHAAP-035. The DD was finalized in early 2014. A notification has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. Because LHAAP-056 is entirely contained within the LHAAP-35A(58) land use control boundary, this requirement is being met under LHAAP-35A(58). A five-year review report in the form of a letter stating the use of the site remains non-residential will be required. Five-year review costs are captured under 48315.1037 (LHAAP-058) because this site falls within the boundary of LHAAP-35A(58). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-049_FORMER ACID STORAGE AREA

WBS Element: 48315.1056

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 8/15/2010

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	3/15/2009	6/15/2009
SI	- -	- -
RI/FS	5/15/2010	8/15/2010
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

LHAAP-49 is the former acid storage area, which was used from 1942 to 1945 for storage and formulation of acids and acid mixtures in support of TNT production during World War II. The NFA ROD was finalized in August 2010. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-059_BUILDING 725

WBS Element: 48315.1057

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 8/15/2008

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	5/15/2007	8/15/2007
SI	- -	- -
RI/FS	5/15/2008	8/15/2008
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

Building 725 at LHAAP-59 was constructed in 1984 to support maintenance activities at the plant as a pesticide storage building. It was determined through site investigations that no significant release had occurred at this site. The NFA DD was finalized in August 2008. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 paragraph 335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. Five-year review costs are captured under 48315.1037 (LHAAP-058) five-year review costs because this site falls within the boundary of LHAAP-35A(58). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LHAAP-065_BUILDING 209

WBS Element: 48315.1058

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 1/15/2014

RC Reason: Study Completed, No Cleanup Required

Program: ENV Restoration, Army

Subprogram: IR

Cost-to-Complete:

Phases	Start	End
PA	3/15/2011	6/15/2011
SI	- -	- -
RI/FS	1/15/2012	1/15/2014
RD	- -	- -
IRA	- -	- -
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2014	9/15/2048

Site Narrative

Building 209 was used for chemical storage for items such as paint and solvents. This building has a concrete floor with floor drains connected to sumps. The site is located just off of 11th street near the fire station. A DD was finalized in early 2014. A notification has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. Because LHAAP-065 is entirely contained within the LHAAP-35A(58) land use control boundary, this requirement is being met under LHAAP-35A(58). A five-year review report in the form of a letter stating the use of the site remains non-residential will be required. Five-year review costs are captured under 48315.1037 (LHAAP-058) five-year review costs because this site falls within the boundary of LHAAP-35A (58). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

LONGHORN ARMY AMMUNITION PLANT

MILITARY MUNITIONS RESPONSE PROGRAM SITES

LHAAP-001-R-01_SOUTH TEST AREA / BOMB TE

WBS Element: 48315.1048

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 9/15/2016

RC Date: 9/15/2016

RC Reason: All Required Cleanup(s) Completed

Program: ENV Restoration, Army

Subprogram: MR

Cost-to-Complete:

Phases	Start	End
PA	2/12/2002	5/1/2003
SI	2/29/2004	6/30/2005
RI/FS	3/31/2005	9/13/2016
RD	- -	- -
IRA	10/31/2007	4/30/2009
RA(C)	4/30/2009	9/15/2016
RA(O)	- -	- -
LTM	9/15/2017	9/15/2048

Site Narrative

This site is approximately 79 acres. It is also known as environmental site LHAAP-027 and is located southeast of Avenue P and the magazine area, at the end of 70th street, near the southern boundary of LHAAP. The site was constructed in 1954 and used to test photoflash bombs that were produced at the facility until about 1956. The bombs were tested by exploding them in the air over an elevated, semi-elliptical earthen test pad. Bombs awaiting testing were apparently stored in three earth-covered concrete bunkers. The bombs tested were 150-pound M120/M120A photoflash bombs, filled with photoflash powder and containing a black powder booster charge for bursting the bomb with a timed nose fuse. The location of the site, for this purpose, was not ideally suited to the task, as fragments from this testing landed beyond the installation boundary. By June 1954, static testing of photoflash bombs had been discontinued because of the possibility of damage and injuries beyond the installation boundary. During the late-1950s, illuminating signal devices were also demilitarized within pits at this site. During the early-1960s, leaking production items were demilitarized in the area. The May 1997 final RI report for Group I Sites indicates approximately 52,000 one-half and one-pound photoflash cartridges were demilitarized at the site in the early-1980s. In 1982 investigations included installation and sampling of two wells and three shallow soil samples. Explosives, metals, chloride and sulfate were detected above background levels in the soil samples. In January 1998, an NFA ROD was signed by the USEPA, based upon the site-specific risk analysis for human and ecological exposure to the contaminants of potential concern for the site. In 2004 the explosive ordnance disposal division at Fort Polk blew in place one 155 mm white phosphorous round. The identification of this round as a live 155 mm white phosphorous round is suspect. Plexus, in the 2005 Environmental Baseline Survey (page 46), states that “Confirmatory Sampling white phosphorous operations at LHAAP were assembly and packout operations only; no loading of these materials was conducted at the site. The white phosphorous rounds were stored and worked in the east line area of Plant 2 (US) Army Toxic and Hazardous Materials Agency (USATHAMA, 1980).” Testing of the payload at LHAAP would not be part of the mission, since it was not manufactured at Longhorn. Others indicate that it was a 105 or 81mm smoke round. A reported demolition site was identified on the northwest perimeter of this site. This was added to the investigation. In FY08 an Engineering Evaluation and Cost Analysis report was completed, approved and signed. An IRA has been

funded with the final Explosives Safety Submission completed in March 2008. The removal action was completed in 2009. The ROD was finalized in 2016. The ROD includes limited groundwater monitoring for perchlorate and LUCs for restrictions against digging and residential use and sign maintenance. Five-year reviews are required. The costs for the installation -wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for this site are captured under 48315.1017 (LHAAP-018). Cleanup/Exit Strategy LTM in the form of LUCs and five-year reviews will continue.

LHAAP-003-R-01_GROUND SIGNAL TEST AREA

WBS Element: 48315.1050

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: 9/15/2016

RC Date: 9/15/2016

RC Reason: All Required Cleanup(s) Completed

Program: ENV Restoration, Army

Subprogram: MR

Cost-to-Complete:

Phases	Start	End
PA	2/12/2002	5/1/2003
SI	2/29/2004	6/30/2005
RI/FS	3/31/2005	9/13/2016
RD	- -	- -
IRA	10/31/2007	4/30/2009
RA(C)	4/30/2009	9/15/2016
RA(O)	- -	- -
LTM	9/15/2017	9/15/2048

Site Narrative

This site, also known as environmental site LHAAP-054, encompasses approximately 80 acres and is located in the southeastern portion of LHAAP. Starting in April 1963 the site was used intermittently for aerial and on-ground testing and destruction of a variety of devices, including red phosphorus smoke wedges, infrared flares, illuminating 60 and 81 mm mortar shells, illuminating 40 to 155 mm cartridges, button bombs, and various types of explosive simulators. The site was also used intermittently over a 20-year period for testing and burnout of rocket motors from Nike-Hercules, Pershing, and Sergeant missiles. Around 1970, one of the Sergeant rocket motors exploded in an excavated pit near the center of the site. Debris was reportedly placed in the resulting crater and backfilled. From late-1988 through 1991, the site was also used for burnout of rocket motors in Pershing missiles destroyed in accordance with the INF Treaty between the US and the former Soviet Union. In January 1998 an NFA ROD for Hazardous, Toxic and Radioactive Waste under CERCLA was signed. The site is currently undeveloped. In December 2004, the Explosive Ordnance Disposal unit at Fort Polk blew in place 105 mm and 81 mm rounds. In FY08 an Engineering Evaluation and Cost Analysis report was completed, approved and signed. An IRA was funded with the final Explosives Safety Submission and completed in March 2008. The removal action was completed in 2009. The ROD was finalized in 2016. The ROD includes limited groundwater monitoring for perchlorate LUCs of restrictions against digging and residential use and sign maintenance. Five-year reviews are required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). The S&R costs for the site are captured under 48315.1017 (LHAAP-018).

Cleanup/Exit Strategy LTM in the form of LUCs and five-year reviews will continue.

LHAAP-004-R-01_PISTOL RANGE

WBS Element: 48315.1052

Alias: None

Regulatory Driver: CERCLA

RRSE: Not assigned

MRSPP: Not assigned

RIP Date: - -

RC Date: 8/15/2010

RC Reason: All Required Cleanup(s) Completed

Program: ENV Restoration, Army

Subprogram: MR

Cost-to-Complete:

Phases	Start	End
PA	9/15/2008	2/15/2009
SI	- -	- -
RI/FS	5/15/2010	8/15/2010
RD	- -	- -
IRA	12/15/2009	1/15/2010
RA(C)	- -	- -
RA(O)	- -	- -
LTM	1/15/2012	9/15/2048

Site Narrative

The former pistol range was known to have been used by LHAAP security personnel for small arms target qualification and recertification. The pistol range was established in the 1950s and used intermittently through 2004. Site investigation results identified areas where the surface and near surface soil was contaminated with lead at concentrations that exceeded the Texas Commission on Environmental Quality soil medium-specific concentrations for industrial use. A non-time critical removal action was completed. The IRA for this site became the FRA. An NFA ROD was finalized in August 2010. A notification (not a remedy or LUC) has been filed in Harrison County, TX stating that the site is suitable for non-residential use in accordance with Texas Administrative Code Title 30 §335.566. A five-year review report in the form of a letter stating the use of the site remains non-residential is required. The costs for the installation-wide five-year reviews are captured under 48315.1037 (LHAAP-058). Cleanup/Exit Strategy LTM in the form of five-year reviews will continue.

SITE CLOSEOUT SUMMARY

Site WBS	Site Name	Site Closeout Date
48315.1005	LHAAP-005_POWER HOUSE BOILER POND	9/15/2015
48315.1009	LHAAP-009_BUILDING 31-W DRUM STORAGE	9/15/2015
48315.1012	LHAAP-013_SUS TNT BET ACTIVE&OLD LANDFIL	12/31/1995
48315.1013	LHAAP-014_AREA 54 BURIAL GRND (SWMU 14)	12/31/1995
48315.1014	LHAAP-015_AREA 49W DRUM STORAGE	5/31/1987
48315.1019	LHAAP-023_BUILDING 707-STORAGE AREA PCBS	1/15/2006
48315.1021	LHAAP-027_SOUTH TEST AREA/BOMB TEST AREA	1/31/1998
48315.1023	LHAAP-032_FORMER TNT WASTEWATER PLT(SWMU	9/30/2007
48315.1024	LHAAP-034_BUILDING 701 PCB STORAGE	9/15/2015
48315.1028	LHAAP-039_25X WASHOUT PAD	8/31/1990
48315.1033	LHAAP-053_STATIC TEST AREA	11/15/2008
48315.1034	LHAAP-054_GRD SIGNAL TEST AREA (LHAAP-XX	1/31/1998
48315.1036	LHAAP-057_RUBBLE BURIAL SITE	9/15/2015
48315.1039	LHAAP-061_POTABLE WTP SEDIMENT POND	9/15/2015
48315.1049	LHAAP-002-R-01_STATIC TEST AREA	10/31/2008
48315.1051	PBC Longhorn_PBC at Longhorn	9/15/2017

COMMUNITY INVOLVEMENT

Technical Review Committee (TRC) Establishment Date:	N/A
Community Involvement Plan (Date Published):	11/15/2013
Restoration Advisory Board (RAB) Establishment Date:	12/31/2004
RAB Adjournment Date:	N/A
RAB Adjournment Reason:	N/A
Additional Community Involvement:	N/A
Administrative Record is located at:	Longhorn Army Trailer, Groudwater Treatment Plant Compound, Highway 134 and Spur 449, Kamack, TX 75661
Information Repository is located at:	Marshall Texas Library, 300 South Alamo, Marshall, TX 75670
Current Technical Assistance for Public Participation (TAPP):	N/A
TAPP Title:	N/A
Potential TAPP:	N/A

FIVE-YEAR / PERIODIC REVIEW SUMMARY

Review Summary Table

Status	Start	End
COMPLETE	6/2/2012	6/2/2013
COMPLETE	6/2/2007	6/2/2008
COMPLETE	6/2/2002	6/2/2002

ROD/DDs associated with the last Five-Year/Periodic Review

Associated ROD/DD Name	Site WBS	Site Name
DD LHAAP-06, 07, 51, 55, 64, 66, 68	48315.1044	LHAAP-068_MOBILE STORAGE TANK PARKING AR
DD LHAAP-19, 56, 65, 69	48315.1045	LHAAP-069_SERVICE STATION UST'S
DD LHAAP-05, 09, 15, 34, 52, 57, 61, 63,	48315.1046	LHAAP-070_LOADING DOCK-MAGAZINE AREA
DD LHAAP-05, 09, 15, 34, 52, 57, 61, 63,	48315.1047	LHAAP-071_OIL SPILL, BLDG 813
ROD FOR LHAAP-001-R AND LHAAP-003-R	48315.1048	LHAAP-001-R-01_SOUTH TEST AREA / BOMB TE
ROD FOR LHAAP-001-R AND LHAAP-003-R	48315.1050	LHAAP-003-R-01_GROUND SIGNAL TEST AREA
ROD FORMER PISTOL RANGE	48315.1052	LHAAP-004-R-01_PISTOL RANGE
ROD FINAL LHAAP-046, PLANT 2 AREA	48315.1053	LHAAP-046_PLANT 2 AREA
PENDING ROD PLANT 3 AREA (LHAAP-047)	48315.1054	LHAAP-047_PLANT 3 AREA
DD LHAAP-19, 56, 65, 69	48315.1055	LHAAP-056_VEHICLE WASH RACK AND O/W SEP
ROD LHAAP-49, FORMER ACID STORAGE AREA	48315.1056	LHAAP-049_FORMER ACID STORAGE AREA
DD LHAAP-59 FORMER PESTICIDE STORAGE BLD	48315.1057	LHAAP-059_BUILDING 725
DD LHAAP-19, 56, 65, 69	48315.1058	LHAAP-065_BUILDING 209

Associated ROD/DD Name	Site WBS	Site Name
NO ACTION ROD 1, 11, 27, 54	48315.1001	LHAAP-001_INERT BURNING GROUNDS (SWMU 1)
LHAAP-02, VACUUM TRUCK OVERNIGHT PARKING	48315.1002	LHAAP-002_VACCUM TRUCK OVERNITE PARKING
PENDING ROD FOR LHAAP-003	48315.1003	LHAAP-003_BUILDING 722-PAINT SHOP
PENDING ROD FOR LHAAP-004	48315.1004	LHAAP-004_LHAAP PILOT WASTEWATER TREATME
DD LHAAP-06, 07, 51, 55, 64, 66, 68	48315.1006	LHAAP-006_BUILDING 54F SOLVENT
DD LHAAP-06, 07, 51, 55, 64, 66, 68	48315.1007	LHAAP-007_BUILDING 50G DRUM PROCESSING
DECISION DOCUMENT LHAAP-08, 48 & 53	48315.1008	LHAAP-008_SEWAGE TREATMENT PLANT
NO ACTION ROD 1, 11, 27, 54	48315.1010	LHAAP-011_SUS TNT BURIAL SITE AT AVE P&Q
CAPPING LANDFILLS 12 & 16	48315.1011	LHAAP-012_ACTIVE LANDFILL (SWMU 12)
LHAAP-12 FINAL ROD	48315.1011	LHAAP-012_ACTIVE LANDFILL (SWMU 12)
CAPPING LANDFILLS 12 & 16	48315.1015	LHAAP-016_OLD LANDFILL (SWMU 16)
FLASHING AREA/BURNING GRND NO 2:LHAAP-17	48315.1016	LHAAP-017_NO 2 FLASHING AREA BRN GROUND(
BURNING GROUND #3(LHAAP-018 & LHAAP-024)	48315.1017	LHAAP-018_BURNING GROUND/WASHOUT POND(SW
DD LHAAP-19, 56, 65, 69	48315.1018	LHAAP-019_CONSTRUCTION MATERIALS LANDFIL
BURNING GROUND #3(LHAAP-018 & LHAAP-024)	48315.1020	LHAAP-024_FORMER UNLINED EVAP POND (SWMU
PLACEHOLDER FOR SITES WITH NO DD IN -R	48315.1022	LHAAP-029_FORMER TNT PRODUCTION AREA(SWM
SUMPS (145) VARIOUS	48315.1025	LHAAP-035_SUMPS (145) VARIOUS
SUMPS (145) VARIOUS	48315.1026	LHAAP-036_EXPLOSIVE WASTE PADS (27)

Associated ROD/DD Name	Site WBS	Site Name
DECISION DOCUMENT FOR LHAAP-045	48315.1029	LHAAP-045_MAGAZINE AREA
FINAL ROD LHAAP-050, FORMER SUMP WATER..	48315.1030	LHAAP-050_FORMER WASTE DISPOSAL FACILITY
DD LHAAP-06, 07, 51, 55, 64, 66, 68	48315.1031	LHAAP-051_PHOTOGRAPHIC LABORATORY/BLDG #
DD LHAAP-05, 09, 15, 34, 52, 57, 61, 63,	48315.1032	LHAAP-052_MAGAZINE AREA WASHOUT
DD LHAAP-06, 07, 51, 55, 64, 66, 68	48315.1035	LHAAP-055_SEPTIC TANK (10)
ROD FINAL LHAAP-35A (058) SHOPS AREA	48315.1037	LHAAP-058_MAINTENANCE COMPLEX
DD LHAAP-60 PESTICIDE STORAGE BUILDINGS	48315.1038	LHAAP-060_FORMER STORAGE BUILDING #411 &
DD LHAAP-05, 09, 15, 34, 52, 57, 61, 63,	48315.1040	LHAAP-063_BURIAL PITS
DD LHAAP-06, 07, 51, 55, 64, 66, 68	48315.1041	LHAAP-064_TRANSFORMER STORAGE
DD LHAAP-06, 07, 51, 55, 64, 66, 68	48315.1042	LHAAP-066_TRANSFORMER AT BLDG 401
FINAL ROD LHAAP-035B (037) & LHAAP-067	48315.1043	LHAAP-067_ABOVE GROUND STORAGE TANK

Results, Actions & Plans

None

LAND USE CONTROLS (LUC) SUMMARY

LUC Title	Site
BURNING GROUND #3(LHAAP-018 & LHAAP-024)	48315.1017
BURNING GROUND #3(LHAAP-018 & LHAAP-024)	48315.1020
CAPPING LANDFILLS 12 & 16	48315.1011
CAPPING LANDFILLS 12 & 16	48315.1015
DECISION DOCUMENT FOR LHAAP-045	48315.1029
DECISION DOCUMENT LHAAP-08, 48 & 53	48315.1008
FINAL ROD LHAAP-035B (037) & LHAAP-067	48315.1043
FINAL ROD LHAAP-050, FORMER SUMP WATER..	48315.1030
FLASHING AREA/BURNING GRND NO 2:LHAAP-17	48315.1016
LHAAP-02, VACUUM TRUCK OVERNIGHT PARKING	48315.1002
LHAAP-12 FINAL ROD	48315.1011
NO ACTION ROD 1, 11, 27, 54	48315.1001
NO ACTION ROD 1, 11, 27, 54	48315.1010
PLACEHOLDER FOR SITES WITH NO DD IN -R	48315.1022
ROD FOR LHAAP-001-R AND LHAAP-003-R	48315.1048
ROD FOR LHAAP-001-R AND LHAAP-003-R	48315.1050
ROD FORMER PISTOL RANGE	48315.1052
ROD LHAAP-49, FORMER ACID STORAGE AREA	48315.1056
SUMPS (145) VARIOUS	48315.1025
SUMPS (145) VARIOUS	48315.1026

Subject:	**Final Minutes, Monthly Managers' Meeting (MMM), Longhorn Army Ammunition Plant (LHAAP)**
Location of Meeting:	**Via Conference Call-In 267-930-4000 with code 041-819-550**
Date of Meeting:	**14 February 2019– 9:00 AM Central Standard Time (CST)**

Attendees:

Army BRAC:	Rose Zeiler (RMZ)
EPA:	Rich Mayer (RM) and Dorelle Harrison
TCEQ:	April Palmie (AP)
USFWS:	Paul Bruckwicki (PB) and Eric Duerkop(ED)
USGS:	Kent Becher (KB)
USACE:	Aaron Williams (AW)
AEC:	Andrew Maly
Bhate:	Kim Nemmers (KN)
APTIM:	Praveen Srivastav (PS) and Bill Foss (BF)

Action Items

Bhate/APTIM

Variance for Well Installation Changes at LHAAP-16: Access issues for the two wells to be installed on the east bank of Harrison Bayou were discussed. PS stated that 2-inch wells would be installed if necessary. BF stated that no variance had been issued because 2-inch wells would only be used if there need to be limitations to the vehicle size. BF stated that the main issue is the resistance to placing gravel to improve access. BF asked if placing a fabric prior to placement of the gravel and then removing using a track hoe at the end of the work would resolve the concerns. PB stated that the area was a mud hole and that additional precipitation has occurred. PB stated that during the previous discussions that the USFWS had stated that their request was to minimize impact and wait for the area to dry out. PB stated that the area dried out for a period of time in the summer but then additional rainfall occurred when mobilization was set in August or September 2018. PB stated that mats of some sort were suggested during the previous onsite meeting. KB stated that remote geoprobes are being used in swampy area but the tracks do tear up the area.PS explained that the plan is not to build a road the entire way but rather to address the hole and then a few other low areas. PS stated that the advantage to using gravel is to allow for access over a period of time, if necessary. BF stated that the mat options were evaluated. KN explained that mats are not meant for a mud hole. KN request that a plan be created to move forward with the project given that LHAAP continues to have rainfall weekly. KN stated that the concerns are understood and that the Bhate team does not believe that the plan affects the site adversely. KN stated that Bhate would restore the area after gravel is removed. KN asked if Bhate could meet the USFWS onsite to walk the areas and finalize a plan for accessing the site. PB stated that there is no approval for brining dump trucks full of gravel onsite. PB stated that a meeting was held previously onsite and that the plan has now changed. RMZ stated that APTIM had been looking at mats and various options and that she recalled that the mats were not readily available. BF stated that the option of purchasing used mats was evaluated and the issue is availability due to the amount of rainfall. Specifically BF explained that companies are not able to get enough timber to manufacture new mats and thus are not selling used mats. BF stated that the option of using a marsh buggy requires customization by the drillers and solid ground beneath the standing water. BF stated that there is not currently solid ground within the mud hole. BF stated that the mats are also limited in this way such that gravel is often placed below the mats to stabilize them. However, timbers would need to be placed to overcome the bottomless mud pit currently observed onsite. RMZ asked if a heavy

duty liner was being placed to ensure that gravel was not being lost over the sides. BF concurred that this is the preferred option. BF asked if the removal of the gravel following site activities changes USFWS' opinion of this option. ED stated that he was not familiar enough with how much area would be torn up with this approach especially with what BF referred to as a bottomless pit. BF stated that the plan is to place enough gravel to "bridge" the area essentially. BF stated that 12-18-inches of gravel across the area is expected with the fabric beneath the gravel. PS stated that mats will also disturb the area because a truck and a track hoe will be used to place them. BF stated that the measured distance is 120 feet. Another 80 feet is also required for a couple of other dips so the total measured distance is approximately 200 feet. BF stated that the goal was not to build a road but to minimize the impact. RMZ asked how long the gravel will be in place. BF stated that the expectation is to leave the gravel in place long enough to install, develop, sample the wells, and then wait to get analytical data back to ensure that the wells are not demonstrating contamination in the shallow aquifer. BF explained that LHAAP-17 is planned for excavation in May or June 2019 and that the equipment for removal of the stone will be available onsite. RMZ asked the Bhate team what level of input they expect from USFWS regarding restoration. BF indicted that they are open to whatever restoration is identified by USFWS. KN stated that meeting onsite seems to be the first step in moving forward. KN stated that the onsite meeting should be held to determine the area of impact and the restoration requirements. BF stated that there is no vegetation currently present that would be impacted. RMZ asked if the Bhate team is open to input on the width of the liner to which BF concurred. BF stated that the planned design included a 12 feet wide double layered liner with 8 feet wide of gravel. KN stated that the USFWS is welcome to inspect the area prior to mobilization of equipment to verify the work completed.

KB asked if the wells scheduled for installation were shallow wells and wondered if an intermediate well could be installed. RMZ stated that only shallow wells are included in the approved work plan and that the results from those wells will drive further decisions and future efforts.

ED asked if this work had been done before where there is a "bottomless mud hole" without a major disturbance. BF stated that the option discussed came from an APTIM civil engineer. BF stated that similar work has been completed at Fort Polk and that he would check to get more specifics if necessary. RMZ asked if the issue is still the same with mats. BF stated that a 12-inch mat is being evaluated due to this issue. RMZ asked how long the mats are. BF stated that they are 8 feet long and 12 feet wide. RMZ stated that the length seems like it could be an issue, and that regardless of approach that there are potential issues.

KN asked for clarification of ED regarding the concern for gravel removal. ED stated that he is worried about impacting the area such as turning of the soil over. KN suggested that we focus on restoration given this concern. ED stated that PB will meet with Scott Beesinger, Bhate's onsite Groundwater Treatment Plant (GWTP) operator, down at the site. KN stated that Scott Beesinger will meet you onsite. KN stated that she understood the path forward to include the site visit, identify best management practices for the area and restoration requirements. KN asked if those are the correct items. ED stated that he agreed as long as Bhate is willing to work with the USFWS to restore the site as desired. ED stated that no matter what is done there will be a significant impact to which KN concurred. ED want to ensure that this work has to be completed and do what is right by the resources. RM asked if anyone had consulted with Scott Beesinger given his 30 plus years working at LHAAP. PS replied that Scott had built couple of roads in the past at LHAAP-17 for installing wells in swampy areas and knows the issues involved.

Monitored Natural Attenuation (MNA) Parameters Technical Memorandum: PS stated that the technical memorandum was sent out towards the end of January 2019. RM stated that Terry Burton is reviewing the document. AP stated that she had reviewed the data and was awaiting input

from EPA also. RM stated that the Table 3-1 in the ITRC has good logic for parameters to be analyzed. RM stated that he didn't know if reducing the parameters may affect sites with perchlorate.

Defense Environmental Restoration Program (DERP) Performance Based Remediation (PBR) Update

KN stated that the transformer is down and that the GWTP is being operated via a generator. KN explained that a tree landed on the lines on December 27th, 2018 where repairs occurred in November 2018. Repairs to the line were completed the next morning, but then the transformer was determined to no longer be properly grounded. The transformer was therefore shutdown. The transformer is installed at a point where SWEPCO ties into the power poles and then power lines run to the GWTP and well field. KN stated that the generator being used is of similar size to the one used in November and was in place on 28 December 2018. In the time since then, various options have been identified and the Army is evaluating those options. A larger generator was brought in and the entire GWTP and well field system for LHAAP-18/24 is now operating. Pumps and motors have been repaired during the past month as well, and water is discharged from the INF pond to the bayou. Additional repairs have been identified now that the well field is operational again. KN stated that the generator will likely be necessary for a couple of months.

RM asked if the same amount of water can be discharged with the generator. KN stated that the same amount is being discharged. AW stated that the USACE is working to get the manufacturer to haul off the transformer to their facility to evaluate the unit and determine the issue. AP asked if there is additional surge protection being evaluated. KN confirmed that surge protection is being evaluated. AP stated that she has concerns about the remedy planned for LHAAP-18/24 which will require a large amount of energy. AW stated that the remedy does not specify the energy source for the remedy.

KN asked everyone to refer to the Document and Issues Tracking Table dated 14 February 2019.

- **Task 1** (Project Management) -
  - KN stated that she needed RM concurrence or comments on the MMM minutes from December 2018. RM stated that he would review and respond.
  - KN stated that the Restoration Advisory Board (RAB) Meeting was moved to 25 April 2019.
- **Task 3** (LHAAP-03) – PS stated that pre-Remedial Design (RD) soil sampling was completed in late November 2018. PS stated that the data had not been provided in the data package for this MMM, but will be included in the RD/Remedial Action Work Plan (RAWP) that is in progress. RMZ asked if this data should be provided monthly. RM and AP agreed that this type of data is best provided in the RD. AP stated that the data is not very useful without figures and other information that will go along with in the RD/RAWP. PS stated that the enforceable schedule date for submittal of draft RD/RAWP to the Regulators is 28 June 2019 but the expectation is that the submittal will be a couple of months earlier.
- **Task 4** (LHAAP-04 Technical Memorandum for Plume Delineation) –PS stated that the RD/RAWP is due out on 22 February 2019 but is likely to be a few days before then. PS stated that groundwater data from site-wide monitoring well sampling performed in January 2019 is included in the validated data provided.
- **Task 5** (LHAAP-12 Annual Remedial Action – Operation [RA-O] Report) – PS stated that the 2017 reports is final and is being placed into the administrative record (AR). The 2018 annual sampling was completed in December 2018 and the data is provided with the

February 2019 validated data package. Also, the RA-O report for the 2018 sampling is in progress.

- **Task 6** (LHAAP-16) – PS stated that no documents are in progress.
- **Task 7** (LHAAP-17) - PS stated that the comments on the draft RD/RAWP from the EPA and TCEQ are being addressed. BF stated that the comments are fairly straight-forward.
- **Task 9** (LHAAP-37) – PS stated that the Year 2, Quarter 1 sampling was completed in November 2018. Validated data from that sampling event is included with the February 2019 data package. The 1st Annual RA-O Report was submitted in January 2019. PS stated that AP comments had been received. AP stated that the biggest comment is that the chart data was not correct. RM clarified that AP meant that the charts are not properly correlating the data. AP stated that the line graphs do not correlate with the data in the tables and that she provided suggestions to improve comparison of data. PS stated that the charts were done in excel so APTIM would check the files and determine where the error is occurring. RM stated he is reviewing the report currently.
- **Task 10** (LHAAP-46) Year 5 RA-O Report –PS stated that the Year 5 Annual RA-O sampling is being completed this month and data package is expected to be available in April. The Year 4 RA-O Report was submitted draft to TCEQ and EPA on 29 January 2019.
- **Task 11** (LHAAP-50) – Year 5 RA-O sampling was completed in November 2018 and is presented with the validated data package for February. PS stated that the next sampling event is planned for May 2019. PS stated that the Explanation of Significant Difference (ESD) for a contingency remedy of in situ bioremediation is in internal review with the Army.
- **Task 12** (LHAAP-58) – KN stated that the entire LHAAP-58 (both eastern and western lobes) was sampled in December 2018 and that data is included with the validated data package provided for the meeting. KN stated that the next sampling event is planned for March 2019 for just the western lobe. RM stated that he noticed that monitoring well MW-20 seemed to rebound. KN stated that she had not had a chance to review the data closely but observed that also. KN stated that ethene is being detected in MW-20, indicative of completed degradation, but not at the level observed in the other areas. KN noted that this well is included in the quarterly sampling planned for March 2019 and additional discussion can occur then.
- **Task 13** (LHAAP-67) – PS stated that the Year 4 RA-O Report is finalized. PS stated that 2nd semi-annual Year 5 sampling will be completed in May 2019.
- **Task 14** (LHAAP-001-R and –003-R) - KN stated that Site LHAAP-001-R-01 and the LHAAP-003-R-01 LTM Report was provided. KN stated that AP had concurred with the LTM Report. KN stated that the LHAAP-001-R-01 groundwater monitoring report was provided to the Regulators also. The data from the last sampling event supported that groundwater sampling is complete based upon perchlorate being less than 17 parts per billion.
- **Task 16** (GWTP) **–** KN stated that AP's comments on the 3rd Quarter 2018 GWTP Report were received in January and that the EPA comments were not yet received. KN stated that the 4th Quarter GWTP Report is being prepared currently as the LHAAP-18/24 data was just received in full.
- **Task 17** (LHAAP-18/24) – KN stated that the results from the December 2018 sampling event will be provided in the next MMM because the analytical data was just received in full for the site. KN stated that LHAAP-18/24 will be sampled next in June 2019.

- **Task 18** (Surface Water) - KN stated that surface water samples were collected in January 2019 and that data is included in the validated data. A technical memorandum with the 2018 data was issued in December for informational purposes.
- **Administrative Record –** PS stated that the update through August 31, 2018 is being sent out shortly. The next AR index is being reviewed and will include September –November.

Update on other DERP Sites

- **LHAAP 18/24** – AW explained that a response to Regulatory comments on the Draft Proposed Plan (PP) for LHAAP-18/24 was submitted on 19 December 2018 back to the TCEQ and EPA. AW stated the PP is draft final and that a few additional comments from the TCEQ were received. AW stated that the cleanup criteria were somehow incorrect and that more recent soil data should be included in the tables. AW stated that the corrections were made. AW indicated that a clean copy along with the redlines will be submitted for the final PP in the next day or so. AW stated that the public meeting material is being reviewed by the Army and then should be available to send to the regulators to review ahead of the public meeting.
- **LHAAP-29** –The PP is final and being prepared for submittal into the AR. The Site 29 ROD is with Army for review and is currently due to the Regulators as draft on 30 May 2019.
- **LHAAP-47** –AW stated that the Post-Screening Investigation (PSI) Report is under Regulatory review. RM warned that there is likely to be a number of comments.
- **Five- Year Review (FYR)** – AW stated that the FYR is under regulatory review.

Field Activities in February 2019

PS stated that LHAAP-37 and LHAAP-46 will be sampled in the next two weeks within the month of February.

BF also pointed out some of the LHAAP-04 data. BF stated that three more wells were installed with two wells installed within the plume and one installed to the southwest and downgradient of the plume. BF stated that the two plume area wells were impacted but the downgradient well is non-detect as expected. BF stated that the wells have been surveyed. BF stated that the potentiometric map generally shows groundwater flow gradient to the southwest. BF continued to explain that the plume has expanded a little but in general there is good plume definition downgradient. RM asked if the plume really expanded or if the data shows the plume better. BF stated that the size expansion is likely due to having more data points but there is some shifting towards the southwest.

Schedule Next Managers' Meeting

The next MMM will be held on 14 March 2019 at 10:00 am CST via conference call.

ACRONYM LIST

AM	Andrew Maly
AP	April Palmie
APTIM	APTIM Federal Services, LLC
AR	Administrative Record
AW	Aaron Williams
Bhate	Bhate Environmental Associates, Inc.
BRAC	Base Realignment and Closure
CST	Central Standard Time
DERP	Defense Environmental Restoration Program
DH	Dorelle Harrison
ED	Eric Duerkop
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
GWTP	Ground Water Treatment Plant
KN	Kim Nemmers
LHAAP	Longhorn Army Ammunition Plant
MMM	Monthly Managers' Meeting
MNA	Monitored Natural Attenuations
PBR	Performance-Based Remediation
PP	Proposed Plan
PS	Praveen Srivastav
PSI	Post-Screening Investigation
RAB	Restoration Advisory Board
RA-O	remedial action – operation
RAWP	Remedial Action Work Plan
RD	Remedial Design
ROD	Record of Decision
RM	Rich Mayer
RMZ	Rose M. Zeiler
TCEQ	Texas Commission on Environmental Quality
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

LHAAP Validated Data Packages for
February 2019 Monthly Manager's Meeting

LHAAP Area	Analytic Method
LHAAP-04	*Supplemental Groundwater Investigation Sampling - November/December 2018 and January 2019* Perchlorate (SW6850)
LHAAP-12	*Year 11 Annual RA-O Groundwater Sampling - December 2018* VOCs (SW8260)
LHAAP-37	*Year 2 Quarter 1, RA-O Groundwater Sampling - November 2018* VOCs (SW8260)
LHAAP-50	*Year 5 Semiannual 1, RA-O Groundwater Sampling - November/December 2018* VOCs (SW8260) Perchlorate (SW6850)
GWTP Effluent	*Weekly Perchlorate Sampling – October/November/December 2018* Perchlorate (6850)
GWTP Effluent	*Weekly, Bi-Weekly, and Monthly Sampling – October/November/December 2018* Ammonia (350.3) Ortho-Phosphate (365.3) Organic Carbon (415.1) VOC (8260C) Metals (6020A) Hexavalent Chromium (7196A) 1,4-Dioxane (8270D-SIM) Anions (9056)
GWTP Influent	*Monthly Sampling – October/December 2018* Metals (6020A) Perchlorate (6850) Hexavalent Chromium (7196A)
GWTP Quarterly	*Influent and Effluent – December 2018* Oil and Grease (1664A) Perchlorate (6850) Metals (6020A) 1,4-Dioxane (8270D-SIM) Chemical Oxygen Demand (410.4) VOC (8260C) Anions (9056)
LHAAP Surface Water	*Quarterly Perchlorate Sampling - January 2019* Perchlorate (6850)
LHAAP-58	*Semi-Annual Sampling Event– December 2018* Alkalinity (310.2/SM2320B) Phosphorus (365.4) Anions (9056) Metals (6020A) VOC (8260C) Total Organic Carbon (415.1) Metabolic Acids (HPLC-METACIDS) Dechlorinating Bacteria (CENSUS) Dissolved Gases (RSK-175) Ferrous Iron (SM3500FE) Sulfide (376.1)

LHAAP-04 Supplemental Groundwater Investigation Sampling - November 2018 through January 2019

	Location Code		04HP01		04HP02		04HP03		04HP04			
	Sample ID		04HP01-181127		04HP02-181128		04HP03-181128		04HP04-181127		04HP04-181127-FD	
	Sample Date		11/27/2018		11/28/2018		11/28/2018		11/27/2018		11/27/2018	
	Location Description:		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch			
Parameter	Units	PCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Perchlorate	µg/L	17	890	J	< 4	UJ	< 4	UJ	23	J	22	J

Notes:

Blue highlighted concentrations exceed the PCL

Some samples may have been diluted due to the concentration(s) of one or more analytes exceeding the upper limit of the calibration curve.

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

PCL – Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Level

ug/L - micrograms per liter

LHAAP-04 Supplemental Groundwater Investigation Sampling - November 2018 through January 2019

	Location Code		04HP05		04HP06		04HP07		04HP08		04HP09			
	Sample ID		04HP05-181127		04HP06-181127		04HP07-181128		04HP08-181129		04HP09-181213		04HP09-181213-FD	
	Sample Date		11/27/2018		11/27/2018		11/28/2018		11/29/2018		12/13/2018		12/13/2018	
	Location Description:		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch			
Parameter	Units	PCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Perchlorate	µg/L	17	7500	J	85	J	20	J	< 2	U	2	J	1.9	J

Notes:

Blue highlighted concentrations exceed the PCL

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U - Undetected: The analyte was analyzed for, but not detected.

PCL – Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Level

ug/L - micrograms per liter

LHAAP-04 Supplemental Groundwater Investigation Sampling - November 2018 through January 2019

	Location Code		04HP10		04HP11		04HP12		04HP13		04WW01		04WW02			
	Sample ID		04HP010-181213		04HP011-181213		04HP012-181213		04HP013-181213		04WW01-190122		04WW02_190121		04WW02_190121-FD	
	Sample Date		12/13/2018		12/13/2018		12/13/2018		12/13/2018		1/22/2019		1/21/2019		1/21/2019	
	Location Description:		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch		Supplemental GW Investigation Hydropunch		Shallow Zone, Downgradient of Plume		Shallow Zone, Upgradient of Plume			
Parameter	Units	PCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Perchlorate	µg/L	17	< 2	U	< 2	U	81	J	< 2	U	< 2	U	< 2	U	< 2	U

Notes:

Blue highlighted concentrations exceed the PCL

Some samples may have been diluted due to the concentration(s) of one or more analytes exceeding the upper limit of the calibration curve.

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

PCL – Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Level

ug/L - micrograms per liter

LHAAP-04 Supplemental Groundwater Investigation Sampling - November 2018 through January 2019

	Location Code		04WW03		04WW04		04WW05		04WW06		04WW07	
	Sample ID		04WW03_190121		04WW04_190121		04WW05_190121		04WW06_190121		04WW07-190122	
	Sample Date		1/21/2019		1/21/2019		1/21/2019		1/21/2019		1/22/2019	
	Location Description:		Shallow Zone, Far Upgradient of Plume		Shallow Zone, Upgradient of Plume		Shallow Zone, Within Plume Area		Shallow Zone, Cross-Gradient to Plume Area		Shallow Zone, Downgradient of Plume Area	
Parameter	Units	PCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Perchlorate	µg/L	17	< 2	U	< 2	U	78		< 2	U	110	

Notes:

Blue highlighted concentrations exceed the PCL

Some samples may have been diluted due to the concentration(s) of one or more analytes exceeding the upper limit of the calibration curve.

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

PCL – Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Level

ug/L - micrograms per liter

LHAAP-04 Supplemental Groundwater Investigation Sampling - November 2018 through January 2019

	Location Code		04WW09				04WW10		04WW11		LHSMW01		LHSMW02	
	Sample ID		04WW09-190122		04WW09-190122-FD		04WW10-190122		04WW11-190122		LHSMW01-190122		LHSMW02_190121	
	Sample Date		1/22/2019		1/22/2019		1/22/2019		1/22/2019		1/22/2019		1/21/2019	
	Location Description:		Shallow Zone, Within Plume Area				Shallow Zone, Within Plume Area		Shallow Zone, Downgradient of Plume Area		Shallow Zone, Cross-Gradient to Plume Area		Shallow Zone, Downgradient of Plume Area	
Parameter	Units	PCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Perchlorate	µg/L	17	2100		2300		10000		< 2	U	< 2	U	< 2	U

Notes:

Blue highlighted concentrations exceed the PCL

Some samples may have been diluted due to the concentration(s) of one or more analytes exceeding the upper limit of the calibration curve.

J - Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

PCL – Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Level

ug/L - micrograms per liter

LHAAP-12 Year 11 Annual RA-O Sampling - December 2018

		Location Code	12WW20		12WW21				12WW24	
		Sample ID	12WW20-181204		12WW21-181204		12WW21-181204-FD		12WW24-181204	
		Sample Date	12/4/2018		12/4/2018		12/4/2018		12/4/2018	
		Location Description	Shallow Zone, unimpacted, outside site boundary		Shallow Zone, unimpacted, outside site boundary				Shallow Zone, impacted, outside site boundary	
Parameter	Units	MCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Volatile Organic Compounds										
cis-1,2-Dichloroethene	µg/L	70	< 0.5	U	< 0.5	U	< 0.5	U	22	
Trichloroethene	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	**48**	
Vinyl Chloride	µg/L	2	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/ bold results indicate concentrations above the MCL.

U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

FD - field duplicate

ID - identification

MCL - maximum contaminant level

RA-O - remedial action operation

Val Qual - validation qualifier

LHAAP-37 Year 2 Quarter 1, RA-O Groundwater Sampling - November 2018

			Location Code	35BSW01		35BSW02		35BWW01		35BWW04				35BWW05		35BWW06	
			Sample ID	35BSW01-181116		35BSW02-181116		35BWW01-181115		35BWW04-181120		35BWW04-181120-FD		35BWW05-181118		35BWW06-181118	
			Sample Date	11/16/2018		11/16/2018		11/15/2018		11/20/2018		11/20/2018		11/18/2018		11/18/2018	
			Location Description	Surface Water Location, Upgradient		Surface Water Location, Downgradient		Shallow zone, unimpacted, within site boundary		Shallow zone, impacted, within site boundary		Shallow zone, impacted, within site boundary		Shallow zone, impacted, within site boundary		Lower shallow zone, unimpacted, within site boundary	
Parameter	Units	MCL		Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Volatile Organic Compounds																	
1,1-Dichloroethene	µg/L	7		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Tetrachloroethene	µg/L	5		< 0.5	U	< 0.5	U	< 0.5	U	6.3		5.3		2.7		< 0.5	U
Trichloroethene	µg/L	5		< 0.5	U	< 0.5	U	< 0.5	U	0.95	J	0.73	J	12		< 0.5	U
Vinyl Chloride	µg/L	2		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/bold results indicate concentrations above the MCL.

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

FD - field duplicate

ID - identification

MCL - maximum contaminant level

RA-O - remedial action operation

Val Qual - validation qualifier

LHAAP-37 Year 2 Quarter 1, RA-O Groundwater Sampling - November 2018

			Location Code	35BWW07		35BWW08		35BWW09		35BWW10		35BWW11		35BWW12		35BWW13	
			Sample ID	35BWW07-181118		35BWW08-181120		35BWW09-181119		35BWW10-181118		35BWW11-181118		35BWW12-181120		35BWW13-181116	
			Sample Date	11/18/2018		11/20/2018		11/19/2018		11/18/2018		11/18/2018		11/20/2018		11/16/2018	
			Location Description	Shallow zone, unimpacted downgradient		Shallow zone, unimpacted, within site boundary		Shallow zone, impacted outside site boundary		Shallow, impacted, within site boundary		Shallow zone, unimpacted, within site boundary		Shallow zone, impacted, within site boundary		Shallow zone, unimpacted, crossgradient	
Parameter	Units	MCL		Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Volatile Organic Compounds																	
1,1-Dichloroethene	µg/L	7		< 0.5	U	< 0.5	U	0.78	J	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70		< 0.5	U	< 0.5	U	1.9		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Tetrachloroethene	µg/L	5		< 0.5	U	< 0.5	U	< 0.5	U	45		< 0.5	U	8.7		1.1	
Trichloroethene	µg/L	5		< 0.5	U	< 0.5	U	580		53		< 0.5	U	0.92	J	< 0.5	U
Vinyl Chloride	µg/L	2		< 0.5	U	< 0.5	U	0.6	J	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/bold results indicate concentrations above the MCL.

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U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

FD - field duplicate

ID - identification

MCL - maximum contaminant level

RA-O - remedial action operation

Val Qual - validation qualifier

LHAAP-37 Year 2 Quarter 1, RA-O Groundwater Sampling - November 2018

			Location Code	35BWW14		35BWW15		35BWW15		35BWW16		35BWW17		35BWW18		35BWW19	
			Sample ID	35BWW14-181120		35BWW15-181116		35BWW15-181116-FD		35BWW16-181116		35BWW17-181116		35BWW18-181119		35BWW19-181119	
			Sample Date	11/20/2018		11/16/2018		11/16/2018		11/16/2018		11/16/2018		11/19/2018		11/19/2018	
			Location Description	Shallow zone, impacted, within site boundary		Shallow zone, impacted, within site boundary		Shallow zone, impacted, within site boundary		Shallow zone, impacted, outside site boundary		Shallow zone, impacted, within site boundary		Shallow zone, unimpacted, outside site boundary		Shallow zone, unimpacted, outside site boundary	
Parameter	Units	MCL		Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Volatile Organic Compounds																	
1,1-Dichloroethene	µg/L	7		2.2		2.6		2.2		1.5		< 0.5	U	< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70		0.91	J	0.68	J	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Tetrachloroethene	µg/L	5		**37**		**11**		**10**		**15**		**5.4**		< 0.5	U	< 0.5	U
Trichloroethene	µg/L	5		**9.1**		**12**		**12**		**6.5**		1.8		< 0.5	U	< 0.5	U
Vinyl Chloride	µg/L	2		< 0.5	U	0.63	J	0.63	J	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/bold results indicate concentrations above the MCL.

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U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

FD - field duplicate

ID - identification

MCL - maximum contaminant level

RA-O - remedial action operation

Val Qual - validation qualifier

LHAAP-37 Year 2 Quarter 1, RA-O Groundwater Sampling - November 2018

			Location Code	35BWW20		35BWW23		35BWW24		35BWW25		35BWW26		LHSMW58			
			Sample ID	35BWW20-181118		35BWW23-181120		35BWW24-181116		35BWW25-181116		35BWW26-181120		LHSMW58-181118		LHSMW58-181118-FD	
			Sample Date	11/18/2018		11/20/2018		11/16/2018		11/16/2018		11/20/2018		11/18/2018		11/18/2018	
			Location Description	Shallow zone, impacted, within site boundary		Shallow zone, unimpacted, outside site boundary		Shallow zone, unimpacted, outside site boundary		Shallow zone, impacted, outside site boundary		Shallow zone, unimpacted, within site boundary		Shallow zone, impacted, within site boundary		Shallow zone, impacted, within site boundary	
Parameter	Units	MCL		Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Volatile Organic Compounds																	
1,1-Dichloroethene	µg/L	7		< 0.5	U	< 0.5	U	0.67	J	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Tetrachloroethene	µg/L	5		34		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	26		25	
Trichloroethene	µg/L	5		6.4		< 0.5	U	2.9		19		< 0.5	U	1.8		1.8	
Vinyl Chloride	µg/L	2		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/bold results indicate concentrations above the MCL.

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

FD - field duplicate

ID - identification

MCL - maximum contaminant level

RA-O - remedial action operation

Val Qual - validation qualifier

LHAAP-50 Year 5 Semiannual 1, RA-O Groundwater Sampling - November/December 2018

			Location Code	50WW05		50WW06		50WW08		50WW09		50WW10		50WW11		
			Sample ID	50WW05-181203		50WW06-181129		50WW08-181128		50WW09-181203		50WW10-181203		50WW11-181128		50WW11-181128-FD
			Sample Date	12/3/2018		11/29/2018		11/28/2018		12/3/2018		12/3/2018		11/28/2018		11/28/2018
			Location Description	Site 50 - NE, lower shallow, outside site boundary.		Site 50 - ENE, outside site boundary.		Site 50 - E, upper shallow, inside site boundary.		Site 50 - E, lower shallow, inside site boundary.		Site 50 - E, intermediate, inside site boundary.		Site 50 - ENE, upper shallow, outside site boundary.		Site 50 - ENE, upper shallow, outside site boundary.
Parameter	Units	MCL/PCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Perchlorate																
Perchlorate	µg/L	17	< 4	U	24		51		< 4	U	< 4	U	2,900		3,200	
VOCs																
1,1-Dichloroethene	µg/L	7	1.2		< 0.5	U	0.62	J	< 0.5	U	< 0.5	U	5.5		5.5	
1,2-Dichloroethane	µg/L	5	1.2		< 0.5	U	1.5		< 0.5	U	< 0.5	U	5.6		5.4	
cis-1,2-Dichloroethene	µg/L	70	18		< 0.5	U	20		7.3		< 0.5	U	18		17	
Tetrachloroethene	µg/L	5	0.86	J	< 0.5	U	1.1		< 0.5	U	< 0.5	U	1.7		1.7	
Trichloroethene	µg/L	5	150		14		240	J	120		< 0.5	U	700	J	710	J
Vinyl Chloride	µg/L	2	< 0.5	U	< 0.5	U	0.66	J	< 0.5	U	< 0.5	U	0.99	J	1	

Notes:

Blue highlighted/bold results indicate concentrations above the MCL/PCL.

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

FD - field duplicate

ID - identification

MCL - maximum contaminant level used for VOCs

PCL - protective concentration level used for Perchlorate

RA-O - remedial action operation

Val Qual - validation qualifier

VOC - volatile organic compound

LHAAP-50 Year 5 Semiannual 1, RA-O Groundwater Sampling - November/December 2018

		Location Code	50WW12		50WW13		50WW14		50WW15		50WW16		50WW17		50WW18	
		Sample ID	50WW12-181128		50WW13-181129		50WW14-181129		50WW15-181130		50WW16-181128		50WW17-181130		50WW18-181130	
		Sample Date	11/28/2018		11/29/2018		11/29/2018		11/30/2018		11/28/2018		11/30/2018		11/30/2018	
		Location Description	Site 50 - ENE, upper shallow, outside site boundary.		Site 50 - E, upper shallow, outside site boundary.		Site 50 - E, lower shallow, outside site boundary, along S. Crockett Ave.		Site 50 - NNE, upper shallow, outside site boundary, along Goose Prairie Creek bridge.		Site 50 - NE, upper shallow, outside site boundary, along Goose Prairie Creek.		Site 50 - NE, fully penetrating shallow, outside site boundary, near Goose Prairie Creek.		Site 50 - NE, upper shallow, outside site boundary, along Goose Prairie Creek.	
Parameter	Units	MCL/PCL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Perchlorate																
Perchlorate	µg/L	17	47,000		1,100		1.9	J	< 4	U	< 4	U	< 4	U	< 4	U
VOCs																
1,1-Dichloroethene	µg/L	7	0.83	J	5.4		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
1,2-Dichloroethane	µg/L	5	0.56	J	12		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70	< 0.5	U	100		3.2		5.9		< 0.5	U	< 0.5	U	< 0.5	U
Tetrachloroethene	µg/L	5	< 0.5	U	4.6		< 0.5	U	2		< 0.5	U	< 0.5	U	< 0.5	U
Trichloroethene	µg/L	5	41	J	2,700		12		9.1		1.9	J	< 0.5	U	< 0.5	U
Vinyl Chloride	µg/L	2	< 0.5	U	1.4		< 0.5	U	1.5		< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/bold results indicate concentrations above the MCL/PCL.

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

FD - field duplicate

ID - identification

MCL - maximum contaminant level used for VOCs

PCL - protective concentration level used for Perchlorate

RA-O - remedial action operation

Val Qual - validation qualifier

VOC - volatile organic compound

LHAAP-50 Year 5 Semiannual 1, RA-O Groundwater Sampling - November/December 2018

			Location Code	50WW21		50WW22		50WW23		50WW24		50WW27			
			Sample ID	50WW21-181130		50WW22-181203		50WW23-181203		50WW24-181130		50WW27-181203		50WW27-181203-FD	
			Sample Date	11/30/2018		12/3/2018		12/3/2018		11/30/2018		12/3/2018		12/3/2018	
			Location Description	Site 50 - E, upper shallow, outside site boundary, east side of S. Crockett Ave.		Site 50 - SE, upper shallow, outside site boundary.		Site 50 - E, upper shallow, outside site boundary.		Site 50 - ENE, upper shallow, outside site boundary.		Site 50 - N, upper shallow, outside site boundary, east of S. Crockett Ave.		Site 50 - N, upper shallow, outside site boundary, east of S. Crockett Ave.	
Parameter	Units	MCL/PCL		Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Perchlorate															
Perchlorate	µg/L	17		< 4	U	< 4	U	< 4	U	< 4	U	< 4	U	< 4	U
VOCs															
1,1-Dichloroethene	µg/L	7		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
1,2-Dichloroethane	µg/L	5		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Tetrachloroethene	µg/L	5		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Trichloroethene	µg/L	5		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
Vinyl Chloride	µg/L	2		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	0.66	J	0.66	J

Notes:

Blue highlighted/bold results indicate concentrations above the MCL/PCL.

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

FD - field duplicate

ID - identification

MCL - maximum contaminant level used for VOCs

PCL - protective concentration level used for Perchlorate

RA-O - remedial action operation

Val Qual - validation qualifier

VOC - volatile organic compound

GWTP Weekly/Effluent Perchlorate Sampling - October 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_100418_BIX 10/4/18	LH18/24-SP650_101018_AIX 10/10/18	LH18/24-SP650_101018_AIX 10/10/18	LH18/24-SP650_101718_BIX 10/17/18	LH18/24-SP650_102318_BIX 10/23/18	LH18/24-SP650_103018_BIX 10/30/18
Location Description			**Collected from a spigot on the discharge of effluent TK-650.**					
			Weekly	Monthly EFF	Weekly	Weekly	Weekly	Weekly
Perchlorate (6850)								
Perchlorate	µg/L	589	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U

µg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

BIX - before ion exchange

AIX - after ion exchange

GWTP Weekly Sampling - October 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_100418 10/4/18	LH18/24-SP650_101018 10/10/18	LH18/24-SP650_101718 10/17/18	LH18/24-SP650_102318 10/23/18	LH18/24-SP650_103018 10/30/18
Location Description			**GWTP–Collected from a spigot on the discharge of effluent TK-650. Sampled Weekly.**				
Ammonia as N (350.3)							
Ammonia as N	mg/L	NV	**11**	**19**	**8.8**	**6**	**11**
Ortho-Phosphate (365.3)							
Ortho-Phosphate	mg/L	NV	**2.36**	**0.48**	**1.92**	**1.71**	**2.5**
Organic Carbon (415.1)							
Total Organic Carbon (TOC)	mg/L	NV	**7.7**	**242 J**	**10.6**	**7.9**	**6.32**

mg/L - milligrams per liter

NV - No Value

J - estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

GWTP Bi-Weekly Sampling - October 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_100418 10/4/18	LH18/24-SP650_101718 10/17/18	LH18/24-SP650_103018 10/30/18
Location Description			**GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Biweekly.**		
Volatile Organic Compounds (8260C)					
1,1,1-Trichloroethane	µg/L	7,230	< 0.5 U	< 0.5 U	< 0.5 U
1,1,2-Trichloroethane	µg/L	216.9	< 0.5 U	< 0.5 U	< 0.5 U
1,1-Dichloroethane	µg/L	14,032	< 0.5 U	< 0.5 U	< 0.5 U
1,1-Dichloroethene	µg/L	253	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dichloroethane	µg/L	181	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dichloropropane	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U
Acetone	µg/L	2,395	< 1.0 U	< 1.0 U	< 1.0 U
Benzene	µg/L	181	< 0.5 U	< 0.5 U	< 0.5 U
Carbon tetrachloride	µg/L	181	< 0.5 U	< 0.5 U	< 0.5 U
Chlorobenzene	µg/L	47,180	< 0.5 U	< 0.5 U	< 0.5 U
Chloroform	µg/L	3,615	< 0.5 U	< 0.5 U	< 0.5 U
Ethylbenzene	µg/L	57,025	< 0.5 U	< 0.5 U	< 0.5 U
m,p-Xylene	µg/L	83.6	< 1.0 U	< 1.0 U	< 1.0 U
Methylene chloride	µg/L	1,699	< 1.0 U	< 1.0 U	< 1.0 U
o-Xylene	µg/L	83.6	< 0.5 U	< 0.5 U	< 0.5 U
Styrene	µg/L	5,987	< 0.5 U	< 0.5 U	< 0.5 U
Tetrachloroethene	µg/L	180.7	< 0.5 U	< 0.5 U	< 0.5 U
Toluene	µg/L	4,189	< 0.5 U	< 0.5 U	< 0.5 U
Trichloroethene	µg/L	181	**1.4**	< 0.5 U	< 0.5 U
Vinyl chloride	µg/L	72	< 0.5 U	**1.7**	< 0.5 U
Anions (9056)					
Chloride	mg/L	NV	**518**	**496**	**524**
Sulfate	mg/L	NV	**79.3**	**34.6**	**124**

µg/L - micrograms per liter

mg/L - milligrams per liter

U- Undetected: The analyte was analyzed for, but not detected.

NV - No Value

GWTP Monthly Influent Sampling - October 2018

Location ID: Sample Date:	Units	LH18/24-SP140_101018 10/10/18
Location Description		**GWTP – Collected from a spigot on the influent to TK-140. Sampled Monthly.**
Metals (6020A)		
Selenium	mg/L	< 0.00200 U
Silver	mg/L	< 0.00100 U
Hexavalent Chromium (7196A)		
Hexavalent Chromium	mg/L	< 0.0100 U
Perchlorate (6850)		
Perchlorate	µg/L	**7,500**

mg/L - milligrams per liter

µg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

GWTP Monthly Effluent Sampling - October 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_101018 10/10/18
Location Description			GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Quarterly.
Volatile Organic Compounds (8260C)			
1,1,1-Trichloroethane	µg/L	7,230	< 0.5 U
1,1,2-Trichloroethane	µg/L	216.9	< 0.5 U
1,1-Dichloroethane	µg/L	14,032	< 0.5 U
1,1-Dichloroethene	µg/L	253	< 0.5 U
1,2-Dichloroethane	µg/L	181	< 0.5 U
1,2-Dichloropropane	µg/L	5	< 0.5 U
Acetone	µg/L	2,395	< 1.0 U
Benzene	µg/L	181	< 0.5 U
Carbon tetrachloride	µg/L	181	< 0.5 U
Chlorobenzene	µg/L	47,180	< 0.5 U
Chloroform	µg/L	3,615	< 0.5 U
Ethylbenzene	µg/L	57,025	< 0.5 U
m,p-Xylene	µg/L	83.6	< 1.0 U
Methylene chloride	µg/L	1,699	< 1.0 U
o-Xylene	µg/L	83.6	< 0.5 U
Styrene	µg/L	5,987	< 0.5 U
Tetrachloroethene	µg/L	180.7	< 0.5 U
Toluene	µg/L	4,189	**0.68 J**
Trichloroethene	µg/L	181	< 0.5 U
Vinyl chloride	µg/L	72	< 0.5 U
Metals (6020A)			
Barium	mg/L	2	**0.174**
Lead	mg/L	0.0046	< 0.00100 U
Selenium	mg/L	0.012	< 0.00200 U
Silver	mg/L	0.003	< 0.00100 U
Hexavalent Chromium (7196A)			
Hexavalent Chromium	mg/L	0.1244	< 0.0100 U
Semi-Volatile Organic Compounds (8270D SIM)			
1,4-Dioxane	µg/L	134.2	**3.5 J**

µg/L - micrograms per liter

mg/L - milligrams per liter

U- Undetected: The analyte was analyzed for, but not detected.

J - estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

GWTP Weekly/Effluent Perchlorate Sampling - November 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_113018_BIX 11/30/18
Location Description			Collected from a spigot on the discharge of effluent TK-650.
			Weekly
Perchlorate (6850)			
Perchlorate	µg/L	589	< 2.0 U

µg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

BIX - before ion exchange

GWTP Weekly Sampling - November 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_113018 11/30/18
Location Description			**GWTP–Collected from a spigot on the discharge of effluent TK-650. Sampled Weekly.**
Ammonia as N (350.3)			
Ammonia as N	mg/L	NV	**81 J**
Ortho-Phosphate (365.3)			
Ortho-Phosphate	mg/L	NV	**2.55 J**
Organic Carbon (415.1)			
Total Organic Carbon (TOC)	mg/L	NV	**69.4**

mg/L - milligrams per liter

NV - No Value

J - estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

GWTP Weekly/Effluent Perchlorate Sampling - December 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_120618_BIX 12/6/18	LH18/24-SP650_120618_BIX 12/6/18	LH18/24-SP650_121218 12/12/18	LH18/24-SP650_121818_BIX 12/18/18	LH18/24-SP650_121818_BIX 12/18/18
Location Description			**Collected from a spigot on the discharge of effluent TK-650.**				
			Monthly EFF	Weekly	Weekly	Quarterly EFF	Weekly
Perchlorate (6850)							
Perchlorate	µg/L	589	**2.0 J**	**2.2 J**	**2.6 J**	< 2.0 U	< 2.0 U

µg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

BIX - before ion exchange

J - estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

GWTP Weekly Sampling - December 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_120618 12/6/18	LH18/24-SP650_121218 12/12/18	LH18/24-SP650_121818 12/18/18
Location Description			**GWTP–Collected from a spigot on the discharge of effluent TK-650. Sampled Weekly.**		
Ammonia as N (350.3)					
Ammonia as N	mg/L	NV	**24**	**14**	**7.9**
Ortho-Phosphate (365.3)					
Ortho-Phosphate	mg/L	NV	**4.76**	**2.23 J**	**1.53**
Organic Carbon (415.1)					
Total Organic Carbon (TOC)	mg/L	NV	**16**	**24.7**	**12.2**

mg/L - milligrams per liter

NV - No Value

J - estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

GWTP Bi-Weekly Sampling - December 2018

Location ID: / Sample Date:	Units	Daily Maximum Conc	LH18/24_SP650_121218 12/12/18
Location Description			**GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Biweekly.**
Volatile Organic Compounds (8260C)			
1,1,1-Trichloroethane	µg/L	7,230	< 0.5 U
1,1,2-Trichloroethane	µg/L	216.9	< 0.5 U
1,1-Dichloroethane	µg/L	14,032	< 0.5 U
1,1-Dichloroethene	µg/L	253	< 0.5 U
1,2-Dichloroethane	µg/L	181	< 0.5 U
1,2-Dichloropropane	µg/L	5	< 0.5 U
Acetone	µg/L	2,395	< 1.0 U
Benzene	µg/L	181	< 0.5 U
Carbon tetrachloride	µg/L	181	< 0.5 U
Chlorobenzene	µg/L	47,180	< 0.5 U
Chloroform	µg/L	3,615	< 0.5 U
Ethylbenzene	µg/L	57,025	< 0.5 U
m,p-Xylene	µg/L	83.6	< 1.0 U
Methylene chloride	µg/L	1,699	< 1.0 U
o-Xylene	µg/L	83.6	< 0.5 U
Styrene	µg/L	5,987	< 0.5 U
Tetrachloroethene	µg/L	180.7	< 0.5 U
Toluene	µg/L	4,189	< 0.5 U
Trichloroethene	µg/L	181	**0.88 J**
Vinyl chloride	µg/L	72	< 0.5 U
Anions (9056)			
Chloride	mg/L	NV	**387**
Sulfate	mg/L	NV	**18.4**

µg/L - micrograms per liter

mg/L - milligrams per liter

U- Undetected: The analyte was analyzed for, but not detected.

NV - No Value

J - estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

GWTP Monthly Influent Sampling - December 2018

Location ID: Sample Date:	Units	LH18/24-SP140_120618 12/6/18
Location Description		**GWTP – Collected from a spigot on the influent to TK-140. Sampled Monthly.**
Metals (6020A)		
Selenium	mg/L	< 0.00200 U
Silver	mg/L	< 0.00100 U
Hexavalent Chromium (7196A)		
Hexavalent Chromium	mg/L	< 0.0100 U
Perchlorate (6850)		
Perchlorate	µg/L	**4,900**

mg/L - milligrams per liter

µg/L - micrograms per liter

U- Undetected: The analyte was analyzed for, but not detected.

GWTP Monthly Effluent Sampling - December 2018

Location ID: / Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_120618 12/6/18
Location Description			GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled monthly
Volatile Organic Compounds (8260C)			
1,1,1-Trichloroethane	µg/L	7,230	< 0.5 U
1,1,2-Trichloroethane	µg/L	216.9	< 0.5 U
1,1-Dichloroethane	µg/L	14,032	< 0.5 U
1,1-Dichloroethene	µg/L	253	< 0.5 U
1,2-Dichloroethane	µg/L	181	< 0.5 U
1,2-Dichloropropane	µg/L	5	< 0.5 U
Acetone	µg/L	2,395	< 1.0 U
Benzene	µg/L	181	< 0.5 U
Carbon tetrachloride	µg/L	181	< 0.5 U
Chlorobenzene	µg/L	47,180	< 0.5 U
Chloroform	µg/L	3,615	< 0.5 U
Ethylbenzene	µg/L	57,025	< 0.5 U
m,p-Xylene	µg/L	83.6	< 1.0 U
Methylene chloride	µg/L	1,699	< 1.0 U
o-Xylene	µg/L	83.6	< 0.5 U
Styrene	µg/L	5,987	< 0.5 U
Tetrachloroethene	µg/L	180.7	< 0.5 U
Toluene	µg/L	4,189	< 0.5 U
Trichloroethene	µg/L	181	**0.89 J**
Vinyl chloride	µg/L	72	< 0.5 U
Metals (6020A)			
Barium	mg/L	2	**0.227**
Lead	mg/L	0.0046	< 0.00100 U
Selenium	mg/L	0.012	< 0.00200 U
Silver	mg/L	0.003	< 0.00100 U
Hexavalent Chromium (7196A)			
Hexavalent Chromium	mg/L	0.1244	< 0.0100 U
Semi-Volatile Organic Compounds (8270D SIM)			
1,4-Dioxane	µg/L	134.2	**3.4**

µg/L - micrograms per liter

mg/L - milligrams per liter

U- Undetected: The analyte was analyzed for, but not detected.

J - estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

GWTP Quarterly Influent Sampling - December 2018

Location ID: / Sample Date:	Units	LH18/24-SP140_121818 12/18/18
Location Description		**GWTP – Collected from a spigot on the influent to TK-140. Sampled Quarterly.**
Oil and Grease (1664A)		
Oil & Grease	mg/L	< 1.00 U
Chemical Oxygen Demand (410.4)		
Chemical Oxygen Demand	mg/L	**8.0 J**
Perchlorate (6850)		
Perchlorate	µg/L	**5,700**
Volatile Organic Compounds (8260C)		
1,1,1,2-Tetrachloroethane	µg/L	< 2.5 U
1,1,1-Trichloroethane	µg/L	< 2.5 U
1,1,2,2-Tetrachloroethane	µg/L	< 2.5 U
1,1,2-Trichloroethane	µg/L	< 2.5 U
1,1-Dichloroethane	µg/L	**6.7**
1,1-Dichloroethene	µg/L	< 2.5 U
1,1-Dichloropropene	µg/L	< 2.5 U
1,2,3-Trichlorobenzene	µg/L	< 2.5 U
1,2,3-Trichloropropane	µg/L	< 2.5 U
1,2,4-Trichlorobenzene	µg/L	< 2.5 U
1,2,4-Trimethylbenzene	µg/L	< 2.5 U
1,2-Dibromo-3-chloropropane	µg/L	< 2.5 U
1,2-Dibromoethane	µg/L	< 2.5 U
1,2-Dichlorobenzene	µg/L	< 2.5 U
1,2-Dichloroethane	µg/L	**29**
1,2-Dichloropropane	µg/L	< 2.5 U
1,3,5-Trimethylbenzene	µg/L	< 2.5 U
1,3-Dichlorobenzene	µg/L	< 2.5 U
1,3-Dichloropropane	µg/L	< 2.5 U
1,4-Dichlorobenzene	µg/L	< 2.5 U
2,2-Dichloropropane	µg/L	< 2.5 U
2-Butanone	µg/L	< 5.0 U
2-Chlorotoluene	µg/L	< 2.5 U
2-Hexanone	µg/L	< 5.0 U
4-Chlorotoluene	µg/L	< 2.5 U
4-Isopropyltoluene	µg/L	< 2.5 U
4-Methyl-2-pentanone	µg/L	< 5.0 U
Acetone	µg/L	< 10 U
Benzene	µg/L	< 2.5 U
Bromobenzene	µg/L	< 2.5 U
Bromochloromethane	µg/L	< 2.5 U
Bromodichloromethane	µg/L	< 2.5 U

Bromoform	µg/L	< 2.5 U
Bromomethane	µg/L	< 2.5 U
Carbon disulfide	µg/L	< 5.0 U
Carbon tetrachloride	µg/L	< 2.5 U
Chlorobenzene	µg/L	< 2.5 U
Chloroethane	µg/L	< 2.5 U
Chloroform	µg/L	**6.9**
Chloromethane	µg/L	< 2.5 U
cis-1,2-Dichloroethene	µg/L	**3,200**
cis-1,3-Dichloropropene	µg/L	< 2.5 U
Dibromochloromethane	µg/L	< 2.5 U
Dibromomethane	µg/L	< 2.5 U
Dichlorodifluoromethane	µg/L	< 2.5 U
Ethylbenzene	µg/L	< 2.5 U
Hexachlorobutadiene	µg/L	< 5.0 U
Isopropylbenzene	µg/L	< 2.5 U
m,p-Xylene	µg/L	< 5.0 U
Methylene chloride	µg/L	**9.3 J**
Naphthalene	µg/L	< 2.5 U
n-Butylbenzene	µg/L	< 2.5 U
n-Propylbenzene	µg/L	< 2.5 U
o-Xylene	µg/L	< 2.5 U
sec-Butylbenzene	µg/L	< 2.5 U
Styrene	µg/L	< 2.5 U
tert-Butylbenzene	µg/L	< 2.5 U
Tetrachloroethene	µg/L	**6.8**
Toluene	µg/L	< 2.5 U
trans-1,2-Dichloroethene	µg/L	**9.0**
trans-1,3-Dichloropropene	µg/L	< 2.5 U
Trichloroethene	µg/L	**2,200**
Trichlorofluoromethane	µg/L	< 2.5 U
Vinyl chloride	µg/L	**910**
Metals (6020A)		
Aluminum	mg/L	**0.0516**
Antimony	mg/L	**0.000654 J**
Arsenic	mg/L	**0.00273**
Barium	mg/L	**0.231**
Beryllium	mg/L	0.00100 U
Cadmium	mg/L	0.00100 U
Calcium	mg/L	**72.6**
Chromium	mg/L	**0.00681**
Cobalt	mg/L	**0.00650**
Iron	mg/L	**3.02**
Lead	mg/L	< 0.00100 U
Magnesium	mg/L	**55.4**
Manganese	mg/L	**0.438**

Nickel	mg/L	**0.0130**
Potassium	mg/L	**1.74**
Selenium	mg/L	< 0.00100 U
Silver	mg/L	< 0.00100 U
Sodium	mg/L	**447**
Thallium	mg/L	< 0.00100 U
Vanadium	mg/L	**0.00123 J**
Zinc	mg/L	**0.108**
Mercury	mg/L	< 0.000100 U
Anions (9056)		
Chloride	mg/L	**408**
Sulfate	mg/L	**233**
Semi-Volatile Organic Compounds (8270D SIM)		
1,4-Dioxane	µg/L	**3.6**

µg/L - micrograms per liter

mg/L - milligrams per liter

J -estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

U- Undetected: The analyte was analyzed for, but not detected.

GWTP Quarterly Effluent Sampling - December 2018

Location ID: / Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650_121818 12/18/18
Location Description			**GWTP – Collected from a spigot on the discharge of effluent TK-650. Sampled Quarterly.**
Oil and Grease (1664A)			
Oil & Grease	mg/L	15	< 1.0 U
Chemical Oxygen Demand (410.4)			
Chemical Oxygen Demand	mg/L	200	**45**
Volatile Organic Compounds (8260C)			
1,1,1-Trichloroethane	µg/L	7,230	< 0.5 U
1,1,2-Trichloroethane	µg/L	216.9	< 0.5 U
1,1-Dichloroethane	µg/L	14,032	< 0.5 U
1,1-Dichloroethene	µg/L	253	< 0.5 U
1,2-Dichloroethane	µg/L	181	< 0.5 U
1,2-Dichloropropane	µg/L	5	< 0.5 U
Acetone	µg/L	2,395	< 2.0 U
Benzene	µg/L	181	< 0.5 U
Carbon tetrachloride	µg/L	181	< 0.5 U
Chlorobenzene	µg/L	47,180	< 0.5 U
Chloroform	µg/L	3,615	< 0.5 U
Ethylbenzene	µg/L	57,025	< 0.5 U
m,p-Xylene	µg/L	83.6	< 1.0 U
Methylene chloride	µg/L	1,699	< 0.5 U
o-Xylene	µg/L	83.6	< 0.5 U
Styrene	µg/L	5,987	< 0.5 U
Tetrachloroethene	µg/L	180.7	< 0.5 U
Toluene	µg/L	4,189	< 0.5 U
Trichloroethene	µg/L	181	**1.2**
Vinyl chloride	µg/L	72	< 0.5 U
Metals (6020A)			
Aluminum	mg/L	1.644	**0.0279**
Antimony	mg/L	NV	**0.000591 J**
Arsenic	mg/L	0.722	**0.000557 J**
Barium	mg/L	2	**0.245**
Beryllium	mg/L	NV	< 0.00100 U
Cadmium	mg/L	0.0034	< 0.00100 U
Calcium	mg/L	NV	**26.8**
Chromium	mg/L	0.752	**0.00182 J**
Cobalt	mg/L	11.495	**0.000808 J**
Iron	mg/L	2.395	**0.208**
Lead	mg/L	0.0046	< 0.00100 U
Magnesium	mg/L	NV	**23.2**

Manganese	mg/L	15.494	**0.163**
Nickel	mg/L	0.184	**0.00209**
Potassium	mg/L	NV	**1.48**
Selenium	mg/L	0.012	< 0.00100 U
Silver	mg/L	0.003	< 0.00100 U
Sodium	mg/L	NV	**262**
Thallium	mg/L	NV	< 0.00100 U
Vanadium	mg/L	3.592	**0.00128 J**
Zinc	mg/L	0.31	**0.0249**
Mercury	mg/L	NV	< 0.000100 U
Anions (9056)			
Chloride	mg/L	NV	**404**
Sulfate	mg/L	NV	**30.8**
Semi-Volatile Organic Compounds (8270D SIM)			
1,4-Dioxane	µg/L	134.2	**2.0**

µg/L - micrograms per liter

mg/L - milligrams per liter

J - estimated value between the detection limit and limit of quantitation and/or due to quality contol issues

NV - No Value

U- Undetected: The analyte was analyzed for, but not detected.

LHAAP-Quarterly Surface Water Sampling - January 2019

Location ID: Sample Date:	Units	PCL	HBW7_011519 1/15/19	HBW10_011519 1/15/19	HBW10_011519_a 1/15/19	HBW1_011519 1/15/19	GPW1_011519 1/15/19	GPW3_011519 1/15/19
Perchlorate (6850)			Harrison Bayou				Goose Prairie Creek	
Perchlorate	µg/L	17	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U

PCL – Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level

µg/L - micrograms per liter

U - Undetected: The analyte was analyzed for, but not detected and reported to the limit of detection.

LHAAP-58 Remedial Action Operation Validated Data - December 2018

Location ID: / Sample Date:	Units	MCL/MSC	03WW01_12121 8 12/12/18	35ASW03_121718 12/17/18	35AWW01_121318 12/13/18	35AWW05_121218 12/12/18	35AWW06_121118 12/11/18	35AWW08_121218 12/12/18	35AWW09_121118 12/11/18	35AWW10_121218 12/12/18	35AWW10_121218_a 12/12/18	35AWW11_121118 12/11/18	35AWW12_121418 12/14/18	35AWW13_121118 12/11/18	35AWW14_121318 12/13/18	35AWW15_121218 12/12/18	35AWW16_121218 12/12/18	35AWW17_121718 12/17/18
Location Description			Site 58 - E, inside site boundary.	Site 58 - E, inside site boundary.	Site 58 - E, inside site boundary.	Site 58 - SW, outside the site boundary.	Site 58 - SW, outside site boundary.	Site 58 - E, inside site boundary.	Site 58 - E, inside site boundary.	Site 58 - ESE, inside site boundary.	Site 58 - ESE, inside site boundary. Duplicate	Site 58 - SE, inside site boundary.	Site 58 - E, outside site boundary.	Site 58 - SE, outside site boundary.	Site 58 - SE, outside site boundary.	Site 58 - W, inside site boundary.	Site 58 - SW, outside site boundary, near Building 744-A.	Site 58 - SW, outside site boundary.
Location Depth			Shallow	Surface Water	Intermediate	Intermediate	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow		Shallow	Shallow	Shallow	Shallow
Lab Package			HS18120736	HS18121030	HS18120913	HS18120736	HS18120642	HS18120736	HS18120642	HS18120736	HS18120736	HS18120642	HS18120913	HS18120642	HS18120913	HS18120736	HS18120736	HS18121030
Alkalinity (SM2320B)																		
Alkalinity, Total	mg/L	NV	**862**	NA	NA	NA	**1,210**	**3420**	**282**	**50.4**	**55.1**	**1,430**	NA	NA	NA	NA	NA	NA
Phosphorus (365.3)																		
Phosphorus	mg/L	NV	**3.05**	NA	NA	NA	**0.467**	**2.43**	**0.112**	**0.244**	**0.253**	**0.169**	NA	NA	NA	NA	NA	NA
Total Organic Carbon (415.1/SM5310C)																		
Total Organic Carbon	mg/L	NV	**42.2**	NA	NA	NA	**685**	**392**	**4.5**	**3.97**	**4.03**	**701**	NA	NA	NA	NA	NA	NA
Metals (6020A)																		
Total Iron	mg/L	NV	**32.9**	NA	NA	NA	**91**	**39.9**	**0.553**	**0.340 J**	**0.166 J**	**59**	NA	NA	NA	NA	NA	NA
Total Manganese	mg/L	14	**4.82**	NA	NA	NA	**8.52**	**9.01**	**0.128**	**0.0474**	**0.0530**	**8**	NA	NA	NA	NA	NA	NA
Dissolved Iron	mg/L	NV	**32.1**	NA	NA	NA	**85.8**	**38.2**	**0.437**	**0.332 J**	**0.227 J**	**55.3**	NA	NA	NA	NA	NA	NA
Dissolved Manganese	mg/L	14	**4.22**	NA	NA	NA	**9.29**	**8.96**	**0.14**	**0.0512**	**0.0567**	**7.91**	NA	NA	NA	NA	NA	NA
Total Arsenic	mg/L	0.01	NA	NA	< 0.00100 U	NA	NA	**0.0593**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds (8260C)																		
1,1,1,2-Tetrachloroethane	µg/L	110	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,1,1-Trichloroethane	µg/L	200	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,1,2,2-Tetrachloroethane	µg/L	14	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,1,2-Trichloroethane	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,1-Dichloroethane	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**1.3**	< 0.5 U	**1.2**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**15**	< 0.5 U	< 0.5 U	< 0.5 U
1,1-Dichloroethene	µg/L	7	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**3.4**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**1.6**	< 0.5 U	< 0.5 U	**10**	< 0.5 U	< 0.5 U	< 0.5 U
1,1-Dichloropropene	µg/L	2.9	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2,3-Trichlorobenzene	µg/L	310	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2,3-Trichloropropane	µg/L	0.041	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2,4-Trichlorobenzene	µg/L	70	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2,4-Trimethylbenzene	µg/L	5100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dibromo-3-chloropropane	µg/L	0.2	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dibromoethane	µg/L	0.05	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dichlorobenzene	µg/L	600	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dichloroethane	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dichloropropane	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,3,5-Trimethylbenzene	µg/L	5100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,3-Dichlorobenzene	µg/L	3100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,3-Dichloropropane	µg/L	29	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,4-Dichlorobenzene	µg/L	75	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
2,2-Dichloropropane	µg/L	42	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
2-Butanone	µg/L	61000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**120**	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**200**	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
2-Chlorotoluene	µg/L	2000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
2-Hexanone	µg/L	6100	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**18**	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
4-Chlorotoluene	µg/L	2000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
4-Isopropyltoluene	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
4-Methyl-2-pentanone	µg/L	8200	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Acetone	µg/L	92000	**25**	**4.5**	< 2.0 U	< 2.0 U	**420**	**76**	**2.1**	< 2.0 U	< 2.0 U	**190**	3.2 UB	< 2.0 U	< 2.0 U	**1.9 J**	< 2.0 U	< 2.0 U
Benzene	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromobenzene	µg/L	2000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromochloromethane	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromodichloromethane	µg/L	4.6	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromoform	µg/L	36	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromomethane	µg/L	140	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Carbon disulfide	µg/L	10000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Carbon tetrachloride	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Chlorobenzene	µg/L	100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Chloroethane	µg/L	41000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Chloroform	µg/L	1000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Chloromethane	µg/L	220	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
cis-1,2-Dichloroethene	µg/L	70	**22**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**8.9 J**	**0.94 J**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**4.6**	< 0.5 U	< 0.5 U	< 0.5 U
cis-1,3-Dichloropropene	µg/L	5.3	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Dibromochloromethane	µg/L	34	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Dibromomethane	µg/L	380	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Dichlorodifluoromethane	µg/L	20000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Ethylbenzene	µg/L	700	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Hexachlorobutadiene	µg/L	20	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Isopropylbenzene	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
m,p-Xylene	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Methylene chloride	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
n-Butylbenzene	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
n-Propylbenzene	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Naphthalene	µg/L	2000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**1.1**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**0.87 J**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
o-Xylene	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
sec-Butylbenzene	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Styrene	µg/L	100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
tert-Butylbenzene	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Tetrachloroethene	µg/L	5	**15**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**450**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Toluene	µg/L	1000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
trans-1,2-Dichloroethene	µg/L	100	**0.62 J**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
trans-1,3-Dichloropropene	µg/L	29	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Trichloroethene	µg/L	5	**5.7**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**12**	**150**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**9.4**	< 0.5 U	< 0.5 U	< 0.5 U
Trichlorofluoromethane	µg/L	31000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Vinyl chloride		2	**7.6**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**1.3**	< 0.5 U	< 0.5 U	< 0.5 U
Volatile Fatty Acids (HPLC-METACIDS)																		
Acetic Acid	mg/L	NV	< 2.0 U	NA	NA	NA	**920**	**120**	< 2.0 U	< 2.0 U	< 2.0 U	**540**	NA	NA	NA	NA	NA	NA
Butyric Acid	mg/L	NV	< 1.0 U	NA	NA	NA	**97**	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	NA	NA	NA	NA	NA	NA
Lactic Acid	mg/L	NV	< 1.0 U	NA	NA	NA	< 10 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 5.0 U	NA	NA	NA	NA	NA	NA
Propionic Acid	mg/L	51	< 1.0 U	NA	NA	NA	**390**	**9.5**	< 1.0 U	< 1.0 U	< 1.0 U	**420**	NA	NA	NA	NA	NA	NA
Pyruvic Acid	mg/L	NV	< 0.10 U	NA	NA	NA	< 1.0 U	**0.48**	< 0.10 U	< 0.10 U	< 0.10 U	< 0.5 U	NA	NA	NA	NA	NA	NA

LHAAP-58 Remedial Action Operation Validated Data - December 2018

Location ID: / Sample Date:	Units	MCL/MSC	03WW01_121218 12/12/18	35ASW03_121718 12/17/18	35AWW01_121318 12/13/18	35AWW05_121218 12/12/18	35AWW06_121118 12/11/18	35AWW08_121218 12/12/18	35AWW09_121118 12/11/18	35AWW10_121218 12/12/18	35AWW10_121218_a 12/12/18	35AWW11_121118 12/11/18	35AWW12_121418 12/14/18	35AWW13_121118 12/11/18	35AWW14_121318 12/13/18	35AWW15_121218 12/12/18	35AWW16_121218 12/12/18	35AWW17_121718 12/17/18
Location Description			Site 58 - E, inside site boundary.	Site 58 - E, inside site boundary.	Site 58 - E, inside site boundary.	Site 58 - SW, outside the site boundary.	Site 58 - SW, outside site boundary.	Site 58 - E, inside site boundary.	Site 58 - E, inside site boundary.	Site 58 - ESE, inside site boundary.	Site 58 - ESE, inside site boundary. Duplicate	Site 58 - SE, inside site boundary.	Site 58 - E, outside site boundary.	Site 58 - SE, outside site boundary.	Site 58 - SE, outside site boundary.	Site 58 - W, inside site boundary.	Site 58 - SW, outside site boundary, near Building 744-A.	Site 58 - SW, outside site boundary.
Location Depth			Shallow	Surface Water	Intermediate	Intermediate	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow		Shallow	Shallow	Shallow	Shallow
Anions (9056A)																		
Chloride	mg/L	NV	336	NA	NA	NA	**858**	**2240**	**1320**	**4.83**	**5.17**	**2,120**	NA	NA	NA	NA	NA	NA
Nitrate	mg/L	10	< 0.100 U	NA	NA	NA	< 0.200 U	**0.147 J**	< 0.100 U	**0.131**	**0.159**	< 0.200 U	NA	NA	NA	NA	NA	NA
Nitrite	mg/L	1	< 0.100 U	NA	NA	NA	< 0.200 U	< 0.100 U	< 0.100 U	< 0.100 U	< 0.100 U	< 0.200 U	NA	NA	NA	NA	NA	NA
Sulfate	mg/L	NV	42.8	NA	NA	NA	**13.4**	**4.76**	**903**	**50.3**	**53.4**	**127**	NA	NA	NA	NA	NA	NA
Dissolved Gases (RSK-175)																		
Carbon Dioxide	µg/L	NV	**390,000**	NA	NA	NA	**790,000**	**290,000**	**420,000**	**430,000**	**450,000**	**820,000**	NA	NA	NA	NA	NA	NA
Ethane	µg/L	NV	< 0.47 U	NA	NA	NA	< 0.47 U	< 0.47 U	< 0.47 U	< 0.47 U	< 0.47 U	< 0.47 U	NA	NA	NA	NA	NA	NA
Ethene	µg/L	NV	**2.3**	NA	NA	NA	**0.44 J**	< 0.55 U	< 0.55 U	**2.8**	< 0.55 U	< 0.55 U	NA	NA	NA	NA	NA	NA
Methane	µg/L	NV	**1,800**	NA	NA	NA	**890**	< 1.0 U	**1,000**	**3,500**	< 1.0 U	**5.5**	NA	NA	NA	NA	NA	NA
Ferrous Iron (SM3500Fe)																		
Ferrous Iron	mg/L	NV	**27.5 J**	NA	NA	NA	**88.1 J**	**21 J**	**0.13 J**	**0.09 J**	**0.07 J**	**20.6 J**	NA	NA	NA	NA	NA	NA
Sulfide (376.1)																		
Sulfide	mg/L	NV	< 1.0 U	NA	NA	NA	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**7.84**	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria																		
BAV1 Vinyl Chloride Reductase	cells/mL	NV	< 0.80 U	NA	NA	NA	< 0.90 U	< 3.1 U	< 0.90 U	< 0.80 U	NA	< 0.50 U	NA	NA	NA	NA	NA	NA
Dehalobacter spp.	cells/mL	NV	**599**	NA	NA	NA	**144000**	**173000**	< 8.6 U	**13.6**	NA	**220000**	NA	NA	NA	NA	NA	NA
Dehalococoides	cells/mL	NV	**10100**	NA	NA	NA	**2.50**	**1200000**	< 0.90 U	**15.8**	NA	**10.6**	NA	NA	NA	NA	NA	NA
tceA Reductase	cells/mL	NV	**6.2**	NA	NA	NA	**1.30**	**313000**	< 0.90 U	**1.1**	NA	**0.2 J**	NA	NA	NA	NA	NA	NA
Vinyl Chloride Reductase	cells/mL	NV	**24400**	NA	NA	NA	< 0.90 U	**366000**	< 0.90 U	**15.2**	NA	< 0.50 U	NA	NA	NA	NA	NA	NA

Blue Highlighting Indicates concentrations above the MCL/MSC

MCL/MSC - Maximum Contaminant Limit/Medium-Specific Concentrations

NA - Not Analyzed

µg/L - micrograms per liter

mg/L - milligrams per liter

J - Estimated: Between the method detection limit and reporting limit and/or due to discrepancies in meeting certain analyte-specific quality control criteria.

UJ - The analyte was not detected; however, the result is estimated due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

NV - No Value

LHAAP-58 Remedial Action Operation Validated Data - December 2018

Location ID: / Sample Date:	Units	MCL/MSC	35AWW18_121718 12/17/18	35AWW18_121718_a 12/17/18	35AWW19_121018 12/10/18	35AWW20_121018 12/10/18	34AWW21_121318 12/13/18	35AWW22_121418 12/14/18	35AWW23_121018 12/10/18	35AWW24_121018 12/10/18	LHSMW06_121318 12/13/18	LHSMW06_121318_a 12/13/18	LHSMW07_121018 12/10/18
Location Description			Site 58 - SSW, outside site boundary.	Site 58 - SSW, outside site boundary. Duplicate	Site 58 - S, outside site boundary.	Site 58 - SW, inside site boundary.	Site 58 - ESE, outside site boundary, beside Building 725.	Site 58 - ENE, outside site boundary.	Site 58 - SW, outside site boundary.	Downgradient Western Plume well	Site 58 - SW, inside site boundary, beside Building 715.	Site 58 - SW, inside site boundary, beside Building 715. Duplicate	Site 58 - SW, outside site boundary.
Location Depth			Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
Lab Package			HS18121030	HS18121030	HS18120569	HS18120569	HS18120913	HS18120913	HS18120569	HS18120569	HS18120913	HS18120913	HS18120569
Alkalinity (SM2320B)													
Alkalinity, Total	mg/L	NV	NA	NA	**198**	**1,190**	NA	NA	**1,110**	**45.9**	NA	NA	**1,640**
Phosphorus (365.3)													
Phosphorus	mg/L	NV	NA	NA	**0.101**	**0.101**	NA	NA	**1.08**	**0.316**	NA	NA	**0.125**
Total Organic Carbon (415.1/SM5310C)													
Total Organic Carbon	mg/L	NV	NA	NA	**2.17**	**19**	NA	NA	**879**	**1.67**	NA	NA	**7.53**
Metals (6020A)													
Total Iron	mg/L	NV	NA	NA	**4.63**	**5.32**	NA	NA	**50.8**	**11.4**	NA	NA	**0.773**
Total Manganese	mg/L	14	NA	NA	**6.65**	**6.19**	NA	NA	**8.04**	**0.134**	NA	NA	**9.4**
Dissolved Iron	mg/L	NV	NA	NA	**4.75**	**4.93**	NA	NA	**46.4**	**11.1**	NA	NA	**0.785**
Dissolved Manganese	mg/L	14	NA	NA	**6.88**	**5.32**	NA	NA	**7.73**	**0.142**	NA	NA	**9.06**
Total Arsenic	mg/L	0.01	NA	NA	NA	NA	NA	NA	NA	NA	< 0.00100 U	< 0.00100 U	NA
Volatile Organic Compounds (8260C)													
1,1,1,2-Tetrachloroethane	µg/L	110	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,1,1-Trichloroethane	µg/L	200	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,1,2,2-Tetrachloroethane	µg/L	14	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,1,2-Trichloroethane	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	**88**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,1-Dichloroethane	µg/L	10000	**0.70 J**	**0.73 J**	**1.8**	**690**	< 0.5 U	< 0.5 U	**1.6**	< 0.5 U	**8.2**	**8.1**	**42**
1,1-Dichloroethene	µg/L	7	**2.0**	**2.3**	**7.5**	**2,700**	< 0.5 U	< 0.5 U	**2.5**	< 0.5 U	**19**	**20**	< 0.5 U
1,1-Dichloropropene	µg/L	2.9	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2,3-Trichlorobenzene	µg/L	310	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2,3-Trichloropropane	µg/L	0.041	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**22**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2,4-Trichlorobenzene	µg/L	70	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2,4-Trimethylbenzene	µg/L	5100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dibromo-3-chloropropane	µg/L	0.2	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dibromoethane	µg/L	0.05	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dichlorobenzene	µg/L	600	< 0.5 U	< 0.5 U	< 0.5 U	**20**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,2-Dichloroethane	µg/L	5	< 0.5 U	< 0.5 U	**2.1**	**26**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**1.9**
1,2-Dichloropropane	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,3,5-Trimethylbenzene	µg/L	5100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,3-Dichlorobenzene	µg/L	3100	< 0.5 U	< 0.5 U	< 0.5 U	**0.99 J**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,3-Dichloropropane	µg/L	29	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
1,4-Dichlorobenzene	µg/L	75	< 0.5 U	< 0.5 U	< 0.5 U	**3.5**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
2,2-Dichloropropane	µg/L	42	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
2-Butanone	µg/L	61000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	**300**	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
2-Chlorotoluene	µg/L	2000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
2-Hexanone	µg/L	6100	< 1.0 U	< 1.0 U	< 1.0 UJ	< 1.0 UJ	< 1.0 U	< 1.0 U	**6.0 J**	< 1.0 UJ	< 1.0 U	< 1.0 U	< 1.0 UJ
4-Chlorotoluene	µg/L	2000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
4-Isopropyltoluene	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
4-Methyl-2-pentanone	µg/L	8200	< 1.0 U	< 1.0 U	< 1.0 UJ	< 1.0 UJ	< 1.0 U	< 1.0 U	**3.9 J**	< 1.0 UJ	< 1.0 U	< 1.0 U	< 1.0 UJ
Acetone	µg/L	92000	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	**120**	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
Benzene	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	**9.0**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromobenzene	µg/L	2000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromochloromethane	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromodichloromethane	µg/L	4.6	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromoform	µg/L	36	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**1.8**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Bromomethane	µg/L	140	< 0.5 U	< 0.5 U	< 0.5 UJ	< 0.5 UJ	< 0.5 U	< 0.5 U	< 0.5 UJ	< 0.5 UJ	< 0.5 U	< 0.5 U	< 0.5 UJ
Carbon disulfide	µg/L	10000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Carbon tetrachloride	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Chlorobenzene	µg/L	100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Chloroethane	µg/L	41000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Chloroform	µg/L	1000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Chloromethane	µg/L	220	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
cis-1,2-Dichloroethene	µg/L	70	< 0.5 U	< 0.5 U	< 0.5 U	**120**	< 0.5 U	< 0.5 U	**20**	< 0.5 U	**55**	**55**	< 0.5 U
cis-1,3-Dichloropropene	µg/L	5.3	< 0.5 U	< 0.5 U	< 0.5 UJ	< 0.5 UJ	< 0.5 U	< 0.5 U	**3.3 J**	< 0.5 UJ	< 0.5 U	< 0.5 U	< 0.5 UJ
Dibromochloromethane	µg/L	34	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Dibromomethane	µg/L	380	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Dichlorodifluoromethane	µg/L	20000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Ethylbenzene	µg/L	700	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Hexachlorobutadiene	µg/L	20	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Isopropylbenzene	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
m,p-Xylene	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Methylene chloride	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
n-Butylbenzene	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
n-Propylbenzene	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Naphthalene	µg/L	2000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
o-Xylene	µg/L	10000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
sec-Butylbenzene	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Styrene	µg/L	100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
tert-Butylbenzene	µg/L	4100	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Tetrachloroethene	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	**1.3**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**1.6**	**1.5**	< 0.5 U
Toluene	µg/L	1000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
trans-1,2-Dichloroethene	µg/L	100	< 0.5 U	< 0.5 U	< 0.5 U	**6.1**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**0.91 J**	**0.94 J**	< 0.5 U
trans-1,3-Dichloropropene	µg/L	29	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**4.7**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Trichloroethene	µg/L	5	< 0.5 U	< 0.5 U	**0.59 J**	**570**	< 0.5 U	< 0.5 U	**5.3**	< 0.5 U	**16**	**16**	< 0.5 U
Trichlorofluoromethane	µg/L	31000	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U
Vinyl chloride	µg/L	2	< 0.5 U	< 0.5 U	< 0.5 U	**110**	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**5.0**	**5.0**	< 0.5 U
Volatile Fatty Acids (HPLC-METACIDS)													
Acetic Acid	mg/L	NV	NA	NA	< 2.0 U	**8.3**	NA	NA	**570**	< 2.0 U	NA	NA	< 2.0 U
Butyric Acid	mg/L	NV	NA	NA	< 1.0 U	< 1.0 U	NA	NA	**140**	< 1.0 U	NA	NA	< 1.0 U
Lactic Acid	mg/L	NV	NA	NA	< 1.0 U	**1.3 J**	NA	NA	< 10.0 U	< 1.0 U	NA	NA	**1.3 J**
Propionic Acid	mg/L	51	NA	NA	< 1.0 U	< 1.0 U	NA	NA	**850**	< 1.0 U	NA	NA	< 1.0 U
Pyruvic Acid	mg/L	NV	NA	NA	< 0.10 U	< 0.10 U	NA	NA	< 1.0 U	< 0.10 U	NA	NA	< 0.10 U

LHAAP-58 Remedial Action Operation Validated Data - December 2018

Location ID: / Sample Date:	Units	MCL/MSC	35AWW18_121718 12/17/18	35AWW18_121718_a 12/17/18	35AWW19_121018 12/10/18	35AWW20_121018 12/10/18	34AWW21_121318 12/13/18	35AWW22_121418 12/14/18	35AWW23_121018 12/10/18	35AWW24_121018 12/10/18	LHSMW06_121318 12/13/18	LHSMW06_121318_a 12/13/18	LHSMW07_121018 12/10/18
Location Description			Site 58 - SSW, outside site boundary.	Site 58 - SSW, outside site boundary. Duplicate	Site 58 - S, outside site boundary.	Site 58 - SW, inside site boundary.	Site 58 - ESE, outside site boundary, beside Building 725.	Site 58 - ENE, outside site boundary.	Site 58 - SW, outside site boundary.	Downgradient Western Plume well	Site 58 - SW, inside site boundary, beside Building 715.	Site 58 - SW, inside site boundary, beside Building 715. Duplicate	Site 58 - SW, outside site boundary.
Location Depth			Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
Anions (9056A)													
Chloride	mg/L	NV	NA	NA	**1,190**	**1,010**	NA	NA	**578**	**109**	NA	NA	**2,030**
Nitrate	mg/L	10	NA	NA	< 0.200 U	< 0.200 U	NA	NA	< 0.200 U	**0.157 J**	NA	NA	< 0.200 U
Nitrite	mg/L	1	NA	NA	< 0.200 U	< 0.200 U	NA	NA	< 0.200 U	< 0.100 U	NA	NA	< 0.200 U
Sulfate	mg/L	NV	NA	NA	**998**	**1,010**	NA	NA	**4.19**	**69.9**	NA	NA	**1,530**
Dissolved Gases (RSK-175)													
Carbon Dioxide	µg/L	NV	NA	NA	**330,000**	**720,000**	NA	NA	**810,000**	**660,000**	NA	NA	**460,000**
Ethane	µg/L	NV	NA	NA	< 0.47 U	< 0.47 U	NA	NA	< 0.47 U	< 0.47 U	NA	NA	**0.46 J**
Ethene	µg/L	NV	NA	NA	< 0.55 U	**1.3**	NA	NA	< 0.55 U	< 0.55 U	NA	NA	**28**
Methane	µg/L	NV	NA	NA	**5.7**	**440**	NA	NA	**2,200**	**68**	NA	NA	**170**
Ferrous Iron (SM3500Fe)													
Ferrous Iron	mg/L	NV	NA	NA	**4.19 J**	**5.01 J**	NA	NA	**50 J**	**0.54 J**	NA	NA	**0.43 J**
Sulfide (376.1)													
Sulfide	mg/L	NV	NA	NA	< 1.00 U	**21.4**	NA	NA	< 1.00 U	< 1.00 U	NA	NA	**14.8**
Dechlorinating Bacteria													
BAV1 Vinyl Chloride Reductase	cells/mL	NV	NA	NA	< 0.50 U	< 1.90 U	NA	NA	**5.4**	< 1.20 U	NA	NA	< 2.10 U
Dehalobacter spp.	cells/mL	NV	NA	NA	**99000**	**285000**	NA	NA	< 25.0 U	**1.50 J**	NA	NA	**166000**
Dehalococoides	cells/mL	NV	NA	NA	**0.50 J**	< 1.90 U	NA	NA	**149**	< 1.20 U	NA	NA	**6080**
tceA Reductase	cells/mL	NV	NA	NA	< 0.50 U	< 1.90 U	NA	NA	< 2.50 U	< 1.20 U	NA	NA	< 2.10 U
Vinyl Chloride Reductase	cells/mL	NV	NA	NA	< 0.50 U	< 1.90 U	NA	NA	**60.7**	< 1.20 U	NA	NA	**8040.0**

Blue Highlighting Indicates concentrations above the MCL/MSC

MCL/MSC - Maximum Contaminant Limit/Medium-Specific Concentrations

NA - Not Analyzed

µg/L - micrograms per liter

mg/L - milligrams per liter

J - Estimated: Between the method detection limit and reporting limit and/or due to disc

UJ - The analyte was not detected; however, the result is estimated due to discrepancies

U - Undetected: The analyte was analyzed for, but not detected.

NV - No Value

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

October 22, 2018

DAIM-ODB-LO

Mr. Rich Mayer
US Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Draft Proposed Plan for LHAAP-18/24, Burning Ground No. 3 and Unlined Evaporation Pond, October 2018, Longhorn Army Ammunition Plant, Karnack, Texas

Dear Mr. Mayer,

The above-referenced document is being transmitted to you for review. In accordance with the FFA, please provide your comments by November 21, 2018.

The document was prepared by HDR Environmental, Operations and Construction, Inc. (HDR) on behalf of the Army as part of HDR's contract for the facility. I ask that Phil Werner, HDR's Project Manager, be copied on any communications related to the project (philip.werner@hdrinc.com).

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX
P. Bruckwicki, Caddo Lake NWR, TX
P. Werner, HDR, Englewood, CO
A. Williams, USACE, Tulsa District, OK
N. Smith, USAEC, San Antonio, TX
K. Nemmers, Bhate, Lakewood, CO (for project files)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

October 22, 2018

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality Superfund Section – MC-136
Remediation Division
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Draft Proposed Plan for LHAAP-18/24, Burning Ground No. 3 and Unlined Evaporation Pond, October 2018, Longhorn Army Ammunition Plant, Karnack, Texas

Dear Ms. Palmie,

The above-referenced document is being transmitted to you for review. In accordance with the FFA, please provide your comments by November 21, 2018.

The document was prepared by HDR Environmental, Operations and Construction, Inc. (HDR) on behalf of the Army as part of HDR's contract for the facility. I ask that Phil Werner, HDR's Project Manager, be copied on any communications related to the project (philip.werner@hdrinc.com).

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX
P. Bruckwicki, Caddo Lake NWR, TX
P. Werner, HDR, Englewood, CO
A. Williams, USACE, Tulsa District, OK
N. Smith, USAEC, San Antonio, TX
K. Nemmers, Bhate, Lakewood, CO (for project files)

Fact Sheet

LHAAP-18/24 Proposed Plan, Burning Ground No. 3 and Unlined Evaporation Pond

PREFERRED REMEDY: Enhanced Groundwater Extraction and Treatment, Land Use Controls (LUCs) in the Shallow Zone and Wilcox Formation, Enhanced In Situ Bioremediation (EISB) Inside and Outside the Containment Area in the Shallow Zone and in the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, and Thermal Dense Non-Aqueous Phase Liquid (DNAPL) Removal

Site History

LHAAP-18/24, the former Burning Ground No. 3 and Unlined Evaporation Pond (UEP), is located in the southeastern portion of LHAAP and covers approximately 34.5 acres. The site is a former industrial area and was used for the treatment, storage, and disposal of solid and liquid explosive, pyrotechnic, and solvent waste by open burning/open detonation, incineration, evaporation, and burial. LHAAP-18 Burning Ground No. 3 operated between 1955 and 1998, while LHAAP-24 UEP operated from 1963 to 1984. After a Remedial Investigation was completed in 2001 and subsequent Post-Screening Investigations in 2013-2014 and 2016, a Revised Feasibility Study was performed in 2017 to evaluate remedial alternatives for the site. The Proposed Plan was completed in February 2019. The preferred remedy identified in the Proposed Plan is Enhanced Groundwater Extraction and Treatment, Land Use Controls (LUCs) in the Shallow Zone and Wilcox Formation, Enhanced In-Situ Bioremediation (EISB) Inside and Outside the Containment Area in the Shallow Zone and in the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, and Thermal Dense Non-Aqueous Phase Liquid (DNAPL) Removal.

Interim Remedial Actions

Sludge from the UEP was removed in 1986 and the impoundment was capped. The majority of impacts to the soil were remediated during the 1997 LHAAP-18/24 Interim Remedial Action (IRA) when approximately 32,000 cubic yards of soil was removed. A groundwater extraction system incorporating approximately 5,000 feet of interceptor-collection trenches (ICTs) and a groundwater treatment plant (GWTP) were installed in 1997 to control the migration of contaminated groundwater and to protect surface water. The area within the ICTs is considered the containment area. Harrison Bayou is located adjacent to the site and drains to Caddo Lake, a drinking water supply.

Human Health Risk Assessment

The Baseline Human Health Risk Assessment (BHHRA) was conducted for LHAAP-18/24 to determine current and future effects of contaminants on human health. Based on the BHHRA, it was concluded that chemicals pose an unacceptable cancer risk and an unacceptable non-cancer hazard to a hypothetical future maintenance worker under an industrial scenario. The risk and Hazard Index values are based on the industrial exposure scenario that includes drinking the water or using the water for hand washing or showering.

Ecological Risk Assessment

A baseline ecological risk assessment (BERA) was performed for the industrial area including LHAAP-18/24. There were no unacceptable risks identified for ecological receptors within LHAAP-18/24 and no action is required.

Chemicals of Concern

- Soil chemicals of concern (COCs) are Volatile Organic Compounds (VOCs) (methylene chloride [MC], trichloroethene [TCE], tetrachloroethene [PCE]), and perchlorate.
- Shallow Zone groundwater COCs are VOCs (MC, TCE, cis-1,2-dichloroethylene (DCE), PCE, benzene, 1,1,2-trichloroethane (TCA), vinyl chloride, bromodichloromethane, 1,3,5-trinitrobenzene, 1,4-dioxane), metals (arsenic, barium, chromium, cobalt, nickel), and perchlorate.
- Wilcox Formation groundwater COCs are VOCs (MC, TCE, cis 1,2-DCE, PCE, benzene, 1,1,2-TCA, 1,1,1,2-tetrachloroethane, vinyl chloride, bromodichloromethane, 1,3,5-trinitrobenzene, 1,4-dioxane), metals (arsenic, barium, cobalt), and perchlorate.

LHAAP-18/24, Burning Ground No. 3 and Unlined Evaporation Pond

Remedial Action Objectives (RAOs)

- Protect human health by preventing human exposure to the groundwater contaminated with COCs.
- Protect human health and the environment by preventing groundwater contaminated with COCs from migrating into nearby surface water.
- Protect human health and the environment by preventing the migration of contaminants to groundwater from potential sources in the soil.
- Return groundwater to its beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

Remedial Alternatives

- Alternative 1 – No Action Alternative – Estimated Cost $0.
- Alternative 2 – Enhanced Groundwater Extraction and Ex-Situ Treatment, LUCs, EISB Inside and Outside the Containment Area and in the Wilcox Formation, Unsaturated Soil Excavation, and Off-Site Disposal – Estimated Cost $34,160,000.
- Alternative 3 – Groundwater Extraction and Treatment, Monitored Natural Attenuation (MNA) Outside the Containment and in the Wilcox Formation, LUCs, and Containment Area Slurry Wall – Estimated Cost $18,650,000.
- Alternative 4 – Enhanced Groundwater Extraction and Treatment, LUCs, EISB Inside and Outside the Containment Area and in
  the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, and Surfactant Enhanced DNAPL Removal – Estimated Cost $32,500,000.
- Alternative 5 – Enhanced Groundwater Extraction and Treatment, LUCs, EISB Inside and Outside the Containment Area and in the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, and Thermal DNAPL Removal – Estimated Cost $32,670,000.
- Alternative 6 – Enhanced Groundwater Extraction and Treatment, LUCs, EISB Inside and Outside the Containment Area and in the Wilcox Formation, Unsaturated Soil Excavation and Off-Site Disposal, and Enhanced DNAPL Remediation using Zero-Valent Iron (ZVI) – Estimated Cost $121,620,000.

The alternatives were evaluated based on effectiveness, implementability, and cost. The No Action alternative provides a comparative baseline, but does not meet RAOs. All five action alternatives protect human health and the environment; however, Alternative 3, which relies the most heavily on containment and LUCs, does not provide the same degree of contaminant removal or treatment in groundwater as the other alternatives. Alternatives 2, 4, 5, and 6 provide a similar level of overall protection and can eventually achieve the cleanup levels for the groundwater COCs due to active remediation and continued operation of the groundwater treatment system for contaminant removal; however, the duration to achieve the cleanup levels vary. Alternative 5 would be a permanent solution and would most effectively and rapidly reduce contaminant concentrations and meet the RAOs. Enhanced groundwater extraction and treatment will stabilize and contain the groundwater plumes. Thermal desorption treatment followed by EISB and MNA of the DNAPL areas is expected remove 99.9% of the VOCs in the shortest timeframe. MNA following the thermal desorption treatment and EISB for groundwater is estimated to reduce COCs to cleanup levels in 20 years, compared to the other alternatives, which would take 30 to hundreds of years.

Description of the Preferred Remedy – Alternative 5:

Soil:

- Excavation and off-site disposal of unsaturated soil exceeding groundwater protection standards. One area beneath the UEP, two areas south, and two areas to the west will be excavated up to 12 feet below ground surface.

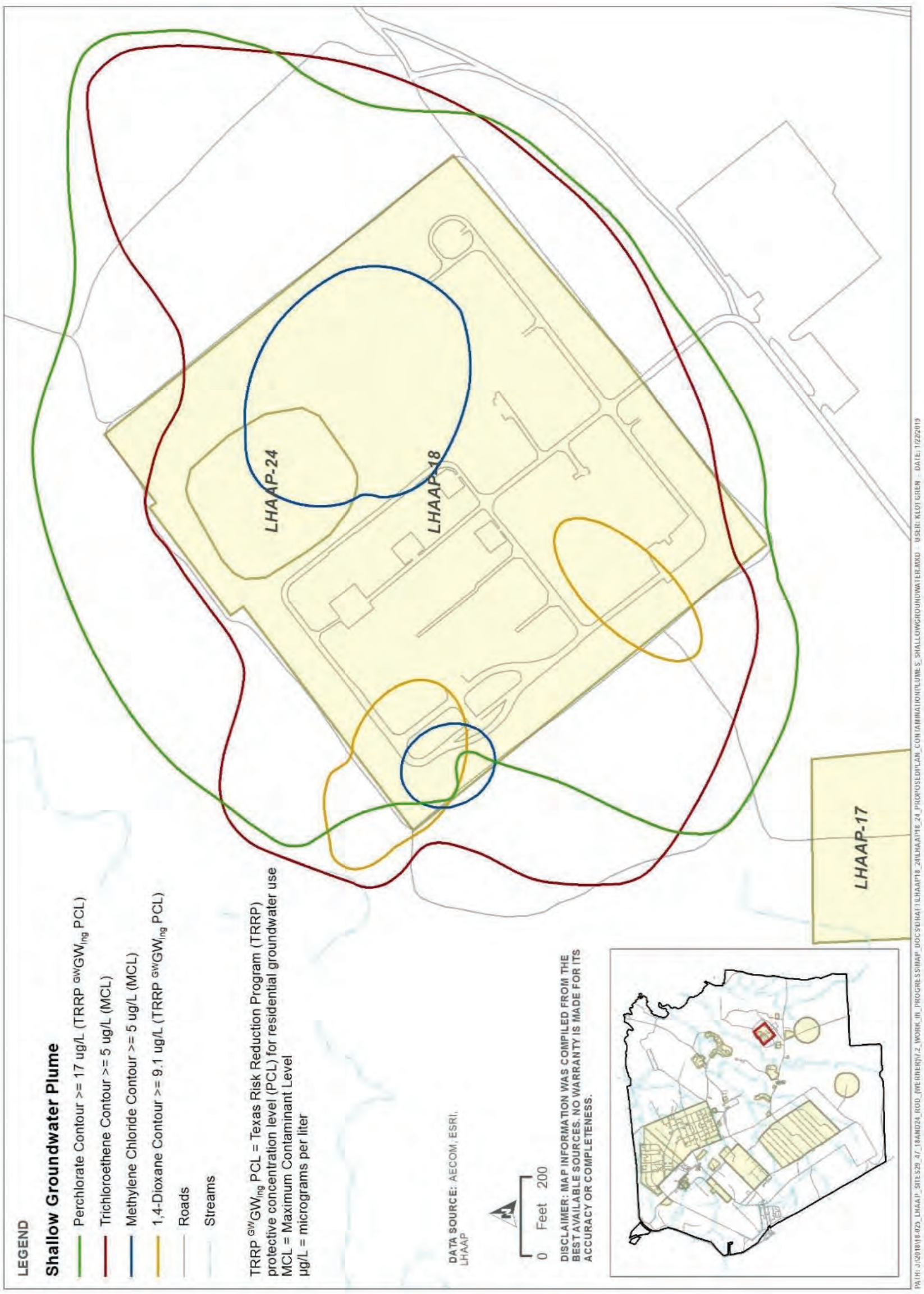
Groundwater:

- Continued use of the existing groundwater extraction system with enhancements may be required until COC concentrations are low enough that MNA can address remaining contamination within the containment area.
- Continued operation of the current or potentially a new GWTP, including contingency use of advanced oxidation process for treatment of 1,4-dioxane.
- Implementation of EISB of shallow zone groundwater outside the containment area at several locations; in the Wilcox formation at three or more locations, and inside the containment at five or more locations or as needed.
- Implementation of thermal desorption to remove DNAPL in two distinct areas inside the containment area at the site.
- MNA for both shallow and intermediate zone groundwater for areas outside the influence of the treatment areas and for areas inside the influence of the treatment areas (after evaluation of EISB) to reduce contaminant levels to cleanup levels and confirm the contaminated groundwater remains localized with minimal migration.
- Maintenance of existing cap over the former UEP.
- Long-term LUCs for the Shallow Zone and Wilcox Formation aquifers that will ensure protection of human health by preventing exposure until levels that allow for unlimited use and unlimited exposure have been attained.

CERCLA Five Year Reviews until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.

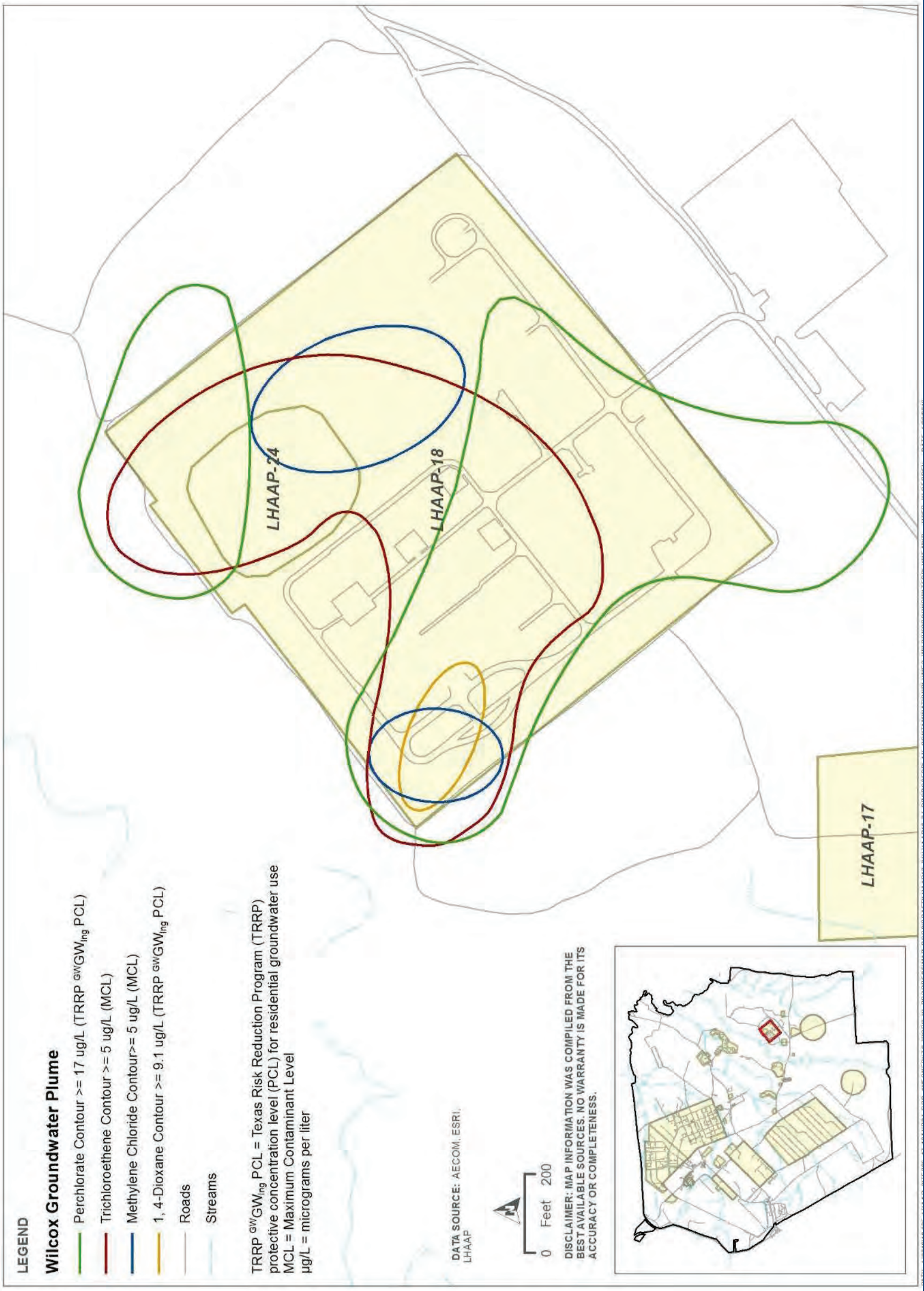
LHAAP-18/24 Groundwater Contamination

Shallow Zone



LHAAP-18/24 Groundwater Contamination

Wilcox Formation



DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

March 7, 2019

DAIM-ODB-LO

Mr. Rich Mayer
U.S. Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Draft Final Remedial Design/Remedial Action Work Plan, LHAAP-17 Burning Ground No. 2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas, March 2019

Dear Mr. Mayer,

One hard copy and one compact disc (CD) of the above-referenced document are being transmitted to you for your records. The document includes revisions based upon the Environmental Protection Agency's (EPA) comments on the Draft version received on February 7, 2019, and Texas Commission on Environmental Quality's (TCEQ) comments received on January 30, 2019. In accordance with Federal Facility Agreement, this Draft Final will be considered Final after 30 days without further comment. Response to comments on the Draft version of the document are included with this Draft Final.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) team, on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX (letter)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy and 1 CD)
A. Williams, USACE, Tulsa District, OK (1 CD)
R. Smith, USACE, Tulsa District, OK (electronic only)
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate, Lakewood, CO (1 CD)
P. Srivastav, APTIM, Houston, TX (letter)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

March 7, 2019

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality
Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Draft Final Remedial Design/Remedial Action Work Plan, LHAAP-17 Burning Ground No. 2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas, March 2019

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Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

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R. Smith, USACE, Tulsa District, OK (electronic only)
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate, Lakewood, CO (1 CD)
P. Srivastav, APTIM, Houston, TX (letter)

From: Mayer, Richard <mayer.richard@epa.gov>
Sent: Thursday, March 14, 2019 3:10 PM
To: Foss, William A.; April Palmie
Cc: Williams, Aaron K SWF @SWT (Aaron.K.Williams@usace.army.mil); Zeiler, Rose M CIV USARMY HQDA ACSIM (US); Smith, Richard P SWT (Richard.P.Smith@usace.army.mil); Andrew.r.maly.civ@mail.mil; Srivastav, Praveen; Harrison, Dorelle; Becher, Kent
Subject: RE: EPA Approval of the Draft Final LHAAP-17 RD/RAWP - March 2019

Good Afternoon Bill, EPA has reviewed the Draft Final LHAAP-17 RD/RAWP dated March 2019 and approves the RTCs and the workplan. EPA would like to point out that on table 1-3, the Sampling Location column was not removed as indicated in the response. Thanks.

From: Foss, William A. <William.Foss@aptim.com>
Sent: Thursday, March 07, 2019 4:35 PM
To: Mayer, Richard <mayer.richard@epa.gov>; April Palmie <april.palmie@tceq.texas.gov>
Cc: Williams, Aaron K SWF @SWT (Aaron.K.Williams@usace.army.mil) <Aaron.K.Williams@usace.army.mil>; Zeiler, Rose M CIV USARMY HQDA ACSIM (US) <rose.m.zeiler.civ@mail.mil>; Smith, Richard P SWT (Richard.P.Smith@usace.army.mil) <Richard.P.Smith@usace.army.mil>; Andrew.r.maly.civ@mail.mil; Srivastav, Praveen <Praveen.Srivastav@aptim.com>
Subject: Draft Final LHAAP-17 RD/RAWP - March 2019

Rich and April,

The Draft Final Remedial Design and Remedial Action Work Plan for LHAAP-17 incorporating responses to EPA and TCEQ comments has been uploaded to the portal under Documents/Recent. Hard copies and CDs are being sent today via UPS for delivery to you tomorrow. The document can be accessed directly on the portal via the link below. Please let us know if you have any comments or questions. Thanks!

Draft Final Remedial Design and Remedial Action Work Plan, LHAAP-17 Burning Ground No. 2 / Flashing Area, Group 2

WILLIAM A. FOSS, PG
Scientist IV

APTIM | Environmental & Sustainability

O 713 243 7095
M 281 380 3241
E William.Foss@aptim.com

APTIM

2500 CityWest Blvd., Suite 1700
Houston, TX 77042

From: April Palmie <april.palmie@tceq.texas.gov>
Sent: Friday, March 15, 2019 4:08 PM
To: Foss, William A.
Cc: Williams, Aaron K SWF @SWT (Aaron.K.Williams@usace.army.mil); Zeiler, Rose M CIV USARMY HQDA ACSIM (US); Smith, Richard P SWT (Richard.P.Smith@usace.army.mil); Andrew.r.maly.civ@mail.mil; Srivastav, Praveen; Mayer, Richard
Subject: TCEQ Comments: Draft Final LHAAP-17 RD/RAWP - March 2019

Hello! My responses for certain comments:
12 – Table 5-1 is the older version of table that is now 5-2. No new content added.
13 – Table 1-2 not revised
14 – Table 4-1 not revised
15 – Table 5-2 was revised but be careful since 5-1 looks the same and needs to be replaced.
16 – Table 8-1 not revised
22 – Figure 8-1 highlighting is helpful but the wells don't match Tables 8-1 and 8-2

I accept the other revisions and RTCs. I'd be fine with replacement pages and a new CD and don't need an updated RTC.

April

From: Foss, William A. <William.Foss@aptim.com>
Sent: Thursday, March 7, 2019 4:35 PM
To: Mayer, Richard <mayer.richard@epa.gov>; April Palmie <april.palmie@tceq.texas.gov>
Cc: Williams, Aaron K SWF @SWT (Aaron.K.Williams@usace.army.mil) <Aaron.K.Williams@usace.army.mil>; Zeiler, Rose M CIV USARMY HQDA ACSIM (US) <rose.m.zeiler.civ@mail.mil>; Smith, Richard P SWT (Richard.P.Smith@usace.army.mil) <Richard.P.Smith@usace.army.mil>; Andrew.r.maly.civ@mail.mil; Srivastav, Praveen <Praveen.Srivastav@aptim.com>
Subject: Draft Final LHAAP-17 RD/RAWP - March 2019

Rich and April,

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Draft Final Remedial Design and Remedial Action Work Plan, LHAAP-17 Burning Ground No. 2 / Flashing Area, Group 2

WILLIAM A. FOSS, PG
Scientist IV

APTIM | Environmental & Sustainability

O 713 243 7095
M 281 380 3241

From: April Palmie <april.palmie@tceq.texas.gov>
Sent: Wednesday, April 17, 2019 3:58 PM
To: Foss, William A.
Cc: Zeiler, Rose M CIV USARMY HQDA ACSIM (US); Williams, Aaron K SWF @SWT (Aaron.K.Williams@usace.army.mil); Srivastav, Praveen; Smith, Richard P SWT (Richard.P.Smith@usace.army.mil); Maly, Andrew R CIV USARMY IMCOM AEC (US); Kim Nemmers (knemmers@bhate.com); Mayer, Richard
Subject: RE: Replacement Pages for 03_2019 Draft Final LHAAP-17 RD/RAWP

EXTERNAL SENDER

Good afternoon. Thank you for sending the replacement pages and new file. I accept the revisions.

April

From: Foss, William A. <William.Foss@aptim.com>
Sent: Thursday, April 4, 2019 2:32 PM
To: Mayer, Richard <mayer.richard@epa.gov>; April Palmie <april.palmie@tceq.texas.gov>
Cc: Zeiler, Rose M CIV USARMY HQDA ACSIM (US) <rose.m.zeiler.civ@mail.mil>; Williams, Aaron K SWF @SWT (Aaron.K.Williams@usace.army.mil) <Aaron.K.Williams@usace.army.mil>; Srivastav, Praveen <Praveen.Srivastav@aptim.com>; Smith, Richard P SWT (Richard.P.Smith@usace.army.mil) <Richard.P.Smith@usace.army.mil>; Maly, Andrew R CIV USARMY IMCOM AEC (US) <andrew.r.maly.civ@mail.mil>; Kim Nemmers (knemmers@bhate.com) <knemmers@bhate.com>
Subject: Replacement Pages for 03_2019 Draft Final LHAAP-17 RD/RAWP

Rich and April,

Replacement CDs and hard copies of replacement pages for the revised tables and figures for the LHAAP-17 Draft Final RD/RAWP are being sent out via UPS today. These are the tables and figures that were revised per TCEQ and EPA comments on the Draft document that were inadvertently not included in the Draft Final version that was sent on March 7th. I am attaching an electronic copy of the transmittal letters for the replacement pages to this email. The revised PDF of the full document has also been uploaded to the portal under Documents/Recent and a direct link to the PDF is included below.
03_2019 Draft Final LHAAP-17 Remedial Design and Remedial Action Work Plan

Please let me know if you have any questions or comments. Thanks!

Bill

WILLIAM A. FOSS, PG
Scientist IV

APTIM | Environmental & Sustainability

O 713 243 7095
M 281 380 3241
E William.Foss@aptim.com

Response to Comments on
Draft Remedial Design / Remedial Action Work Plan
LHAAP-17 Burning Ground No. 2 / Flashing Area, Group 2

Document Date: 27 December 2018
Comment Date: 7 February 2019

Reviewer: Mr. Richard Mayer, USEPA
Respondent: Dr. Rose Zeiler

1. Respondent Concurs (C), Does Not Concur (D), Takes Exception (E), or Delete (X)
2. Commenter Agrees (A) with response, or Does Not Agree (D) with response

Comment No.	Section, Page ref.	USEPA Comment	C, D, E, or X[1]	Response	A or D[2]
1.	Page 1-2, Table 1-1	Under chemicals of concern for soils, 2,4-dinitrotolune is misspelled.	C	Text will be revised to correct the typographical error.	
2.	Page 1-6, Section 1.5	Bhate, 2018 should be Bhate, 2018b	C	Text will be revised to correct the reference as suggested.	
3.	Table 1-3	Table 1-3 indicates that 5 soil sample locations are above the cleanup levels for Barium; however, Figure 3-1 indicates 11 soil sample locations. Which is correct?	C	Table 1-3 was duplicated from Table 2-11 of the Final ROD, and the sample locations referred to in the ROD table were the known exceedances at that time. Figure 3-1 shows the exceedances identified following the conclusion of the PDI sampling. Table 1-3 has been revised to remove the Sample Location column since the information in it is not referenced in the document, and Figure 3-1 has been revised to show 17SS22 as a barium exceedance location.	
4.	Page 2-1, Section 2.1	The text indicates that a clay layer between the uppermost alluvial zone and Wilcox acts as an aquitard. Based on the water levels provided (several sections further in the report) there is a slight gradient downward which suggests using the term aquiclude instead of aquitard or the term leaky aquitard.	C	The text has been revised to refer to the clay layer as an aquiclude.	

Comment No.	Section, Page ref.	USEPA Comment	C, D, E, or X[1]	Response	A or D[2]
		Confined conditions are seen with most aquitards.			
5.	Figure 2-2	Monitoring well MW-20 is screened between a perched zone and the shallow groundwater. The southwest corner of LHAAP 18/24 has been known to have a perched zone, so it is questionable if the water levels at that location represent the first shallow water zone. However, since there are no other wells in that area that are in the shallow zone, the water levels are most likely similar to those in MW-7.	C	It is assumed that the comment refers to Figure 2-1 instead of Figure 2-2, since neither of the wells referred to are shown on Figure 2-2. Reviewer is correct that MW-20 and nearby 18CPTMW22R are screened ~10' shallower than MW-7. The potentiometric surface figure for the Shallow Zone (Figure 2-1) has been revised to remove the contours above 168.6 and revise the contours to remove the influence of the two locations. The groundwater elevations for MW-20 and 18CPTMW22R are still shown, but a note has been added to the legend stating "The groundwater elevations for MW-20 and 18CPTMW22R were not used to draw potentiometric contours because they are screened significantly shallower than other nearby wells and may not represent elevations in the shallow zone."	
6.	Figure 5-2	The Figure indicates two places in the flow diagram where telemetry will be used. The narratives in sections 5 and 7 do not mention if this will be used. Please clarify	C	The telemetry shown on Figure 5-2 is explained in Note 2 on the figure as a control to close the air line operating the transfer pump (pumping water from LHAAP-17 to the GWTP) if the level in the equalization tank at the GWTP trips the high-level alarm. If the transfer pump remains shut down long enough, the high-level alarm in the holding tank will trigger the pumps in the extraction wells to shut down as well. Discussion of the telemetry connection has been added to Section 5.4.2.	
7.	Page 4-1, Section 4.2	The text refers to Figure 2-1, which should be Figure 3-1. EPA recommends adding the concentrations of explosives and barium that exceeded the health criteria to the Figure.	C/D	The text reference has been revised to refer to Figure 3-1. Each location shown as highlighted may have up to 3 different COC concentrations exceeding the health criteria at one or more depths. Adding the data (COC, depth, and concentration for each	

Comment No.	Section, Page ref.	USEPA Comment	C, D, E, or X[1]	Response	A or D[2]
				exceedance) to each location would make the figure extremely difficult to read and would obscure the primary purpose of showing the overall pattern of the soil areas requiring excavation. The title of the figure has been revised to "Soil Sample Locations with Concentrations Exceeding the Cleanup Levels" to clarify the purpose. A reference to Table 3-1 has been added to the legend of Figure 3-1.	
8.	References	Please add Plexus, 2005 report to the list.	C	The Plexus, 2005 report has been added to the list of references.	
9.	List of Acronyms	There are several acronyms missing from list. Please add the following: MEGA, MATOC, MMRP, FFA, BRAC, TCDD, DCE, mg/kg, TEC, MOA, gpm, PPE, and ORP. Also, O&M needs to be defined on page 1-6 and added to list. The same comment applies to DO. ECP can be removed from the list since it is not used in the body of the report.	C	The acronyms list has been updated as requested and a thorough edit of the document has been performed to properly define the first use of each acronym in the text. The following were only used once in the document and the abbreviation/acronym was removed from the text and is not shown in the table of acronyms and abbreviations: MEGA, MATOC, MMRP, BRAC, TEC, PPE, ORP, DO	

Response to Comments on
Draft Remedial Design / Remedial Action Work Plan
LHAAP-17 Burning Ground No. 2 / Flashing Area, Group 2

Document Date: 27 December 2018
Comment Date: 30 January 2019

Reviewer: Ms. April Palmie, TCEQ
Respondent: Dr. Rose Zeiler

1. Respondent Concurs (C), Does Not Concur (D), Takes Exception (E), or Delete (X)
2. Commenter Agrees (A) with response, or Does Not Agree (D) with response

Comment No.	Section, Page ref.	TCEQ Comment	C, D, E, or X[1]	Response	A or D[2]
1.	Section 1.5, Page 1-6	Excavation sidewall – The composite strategy for the small excavation areas is technically reasonable but may result in the excavation staying unfilled longer than necessary if the composite fails. If you had samples from each wall, it would speed the process for backfilling the excavation.	C	The potential risk of needing to keep the small excavations open longer for additional sampling was considered in the selection of the sampling method. The expected duration of activities and plan to perform the smaller excavations first will allow time for the additional sampling (if needed) without delaying other site activities.	
		Baseline groundwater – The described strategy is appropriate for 17WW01 and should also be evaluated for 17WW02. The TCE and perchlorate concentrations in 17WW02 also decreased by several orders of magnitude between 2009 and 2017 sampling. Were the samples taken from the same interval?	C	The sample collected from 17WW02 was collected using a pump inlet depth of 17 feet in 2017 and 20 feet in 2010. Sections 1.5 and 5.3 have been updated to include a similar discussion for 17WW02.	
2.	Section 2.3 Page 2-2	Revise refuge acreage to 7,100 acres	C	Text has been revised as requested.	
3.	Section 2-5, Page 2-3	This section discusses water wells. Please include the discussed water wells on Figure 1-2 (or another figure).	C	A new figure (Figure 2-3) has been added showing the location of the drinking water supply wells near LHAAP and a callout has been added to Section 2.5.	

Comment No.	Section, Page ref.	TCEQ Comment	C, D, E, or X[1]	Response	A or D[2]
4.	Section 3 and general	Search for abbreviated dates and replace all. Examples: 12 Sep 2018 should be September 12, 2018 and 11-15 Jan 2018 should be January 11-15, 2018	C	Text has been revised as requested.	
5.	Section 3-1, Page 3-1	1st paragraph, 2nd sentence – change underwater to under water. 2nd paragraph, add references to the area names from Figure 4-1. Last sentence add reference to Figure 4-1.	C C	Text has been revised as requested. Text has been revised to add the references to the area names and a reference to Figure 4-1 as requested.	
6.	Section 5.4.1, Page 5-3	2nd paragraph – Should the 2nd sentence reference 17WW06 and 17WW02, rather than 17WW01?	D	During the pumping test, the initial pumping well was 17WW02. After 48 hours of pumping in 17WW02, pumping began at 17WW01 and 17WW06.	
7.	Section 5.5, Page 5-4	Additional 17 wells should be sampled and results from certain 18/24 wells should be evaluated during extraction period. At least 17WW03 and 130 should be sampled. The results for MW-18 and MW-19 should be included for evaluation purposes to confirm the 18/24 plume is not being dragged by the pumping wells.	C	Wells 17WW03 and 130 have been added to the monthly/quarterly sampling performed during the extraction period. Semiannual data from MW-18 and MW-19 collected as part of the LHAAP-18/24 monitoring will be included in the RA-O reporting and used to evaluate the impact on the 18/24 plume. Text has been modified to reflect these changes.	
8.	Section 6.1, Page 6-2	3rd bullet, Remove comma between Refuge and Manager	C	Text has been revised as requested.	
9.	Section 8.1, Page 8-1	If 17WW01 is included as an extraction well, it should also be sampled	C	The first sentence of Section 8.1 has been revised to include sampling of 17WW01 if it is included as an extraction well.	
10.	Section 8.3, Page 8-1	Certain additional well should also be sampled at baseline and during pumping (see comment 7).	C	See response to Comment #7. Text has been revised in Section 8.3 for consistency with that response.	
11.	Section 8.3.1, Page 8-2	All impacted wells should be included in the baseline sampling event.	C	17WW03 and 130 have been added to the baseline sampling event as they are the only other LHAAP-17 wells impacted with COCs.	

Comment No.	Section, Page ref.	TCEQ Comment	C, D, E, or X[1]	Response	A or D[2]
12.	Tables	Please add a table to show cumulative groundwater results. The call-out boxes on the figure are helpful but we also need a table.	C	Table 5-1 has been added to show the data requested in tabular form. The previous Table 5-1 has been renamed to 5-2 and callouts have been revised accordingly.	
13.	Table 1-2	Please revise PCL heading to: TRRP $^{GW}GW_{Ing}$ PCL (and revise the note)	C	Table 1-2 has been revised as requested.	
14.	Table 4-1	Area H – The excavation walls cover a long distance. The north and south walls should have two samples each. 17SS28 is not suitable to serve as a confirmation sample for the south wall of Area H.	C	Table 4-1 has been revised as requested to include two samples for the north wall of Area H and one additional sample for the south wall of Area H.	
15.	Table 5-1	Would it be possible to add data for 17WW01?	C	Data for an assumed pumping rate of 1.5 gpm in 17WW01 has been added to the table. The table has been renumbered to 5-2 to accommodate the addition of the table referred to in the response to TCEQ Comment #12	
16.	Table 8-1	Suggest removal of 18WW10 from the list as it is part of 18/24 monitoring and not likely to be impacted by pumping at 17.	C	18WW10 has been removed from the table as requested.	
17.	Figure 4-1	This is very helpful figure. Please change one of the greens to a different color (too similar). The greens look different on the pdf but not on the printout.	C	Figure 4-1 has been revised as requested.	
18.	Figure 5-2	Between V-21 and P-20 the line looks like water line. Should this be air line? Is that a valve with port or just on/off valve after P-20? Would a sample port also be useful at that location (blended)? If 17WW01 is included, would it also have a sample port?	C D C	Figure 5-2 has been revised to show the referenced line as an air line. The valve shown is an on/off valve only. There will be sample ports for each extraction well, so collecting a blended sample does not really have value since the water will ultimately be mixed in the equalization tank at the GWTP with water from LHAAP-18/24. If 17WW01 is added as an extraction well, it will be set up exactly as the other wells are shown. A note has been added to the figure stating that 17WW01	

Comment No.	Section, Page ref.	TCEQ Comment	C, D, E, or X[1]	Response	A or D[2]
				may be added using the same design based on the results of the baseline sampling.	
19.	Figure 5-3	Add radius of influence for 17WW01	C	An estimated radius of influence of 200 feet has been added to Figure 5-3 for 17WW01 assuming a pumping rate of 1.5 gpm.	
20.	Figure 6-1	Please remove 18WW10/18WW11 from the LUC boundary for site 17. This well belongs with 18/24 and we can include it with that LUC. The north boundary of the LUC could go from 17WW15 to MW-18 instead.	C	The LHAAP-17 LUC boundary shown on Figure 6-1 has been redrawn to match a boundary map showing LHAAP-16, -17, and -18/24 LUC boundaries previously submitted by the Army. The wells north and east of the 17WW11/12/20 cluster will be within the LHAAP-18/24 LUC boundary.	
21.	Figure 7-1	Add 17WW01.	C	17WW01 has been added as a possible extraction well as requested.	
22.	Figure 8-1	Include all wells and change the color, symbol, or highlight for MNA wells. Don't hide non-MNA wells.	C	Figure 8-1 has been revised as requested.	
23.	Appendix D	Form will need to be revised to include 17WW01 (if included as extraction well)	C	The form provided is an example that will be updated to meet the needs of the system as installed.	

Draft Final
Remedial Design and Remedial Action Work Plan, LHAAP-17 Burning Ground No. 2 / Flashing Area, Group 2

Longhorn Army Ammunition Plant
Karnack, Texas

Prepared for U.S. Army Corps of Engineers, Tulsa District
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Acronyms and Abbreviations

µg/L	micrograms per liter
AECOM	AECOM Engineering Company
APTIM	Aptim Federal Services, LLC
Bgs	below ground surface
Bhate	Bhate Environmental, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
COPEC	chemical of potential ecological concern
CY	cubic yards
DCE	dichloroethene
DNT	dinitrotoluene
ESD	Explanation of Significant Differences
FFA	Federal Facility Agreement
gpm	gallons per minute
GPS	global positioning system
GWTP	groundwater treatment plant
HDPE	high density polyethylene pipe
IWWP	Installation-Wide Work Plan
LHAAP	Longhorn Army Ammunition Plant
LOE	line of evidence
LTM	long-term monitoring
LUC	land use control
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
MOA	Memorandum of Agreement
NCP	National Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
PDI	Pre-Design Investigation
RA	remedial action
RACR	Response Action Completion Report
RA-O	Remedial Action-Operation
RAOs	remedial action objectives
RAWP	Remedial Action Work Plan
RD	remedial design
ROD	Record of Decision
Shaw	Shaw Environmental, Inc.
TAC	Texas Administrative Code
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin

Acronyms and Abbreviations (continued)

TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TNT	2,4,6-trinitrotoluene
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Tulsa District, contracted Bhate Environmental, Inc. (Bhate), under the Omaha Multiple Environmental Government Acquisition National Small Business Multiple Award Task Order Contract Environmental Remediation Services with Military Munitions Response Program, Task Order No. W9128BV17F0150 to conduct environmental restoration of LHAAP-17 at Longhorn Army Ammunition Plant (LHAAP). The Bhate Team is comprised of Bhate and Aptim Federal Services, LLC (APTIM). This Remedial Design (RD) and Remedial Action Work Plan (RAWP) was prepared to describe the design elements selected to implement the remedy for LHAAP-17 described in the Final Record of Decision (ROD) (Shaw 2016) and the actions necessary to implement them.

1.1 Site Description

LHAAP is approximately 14 miles northeast of Marshall, Texas and approximately 40 miles west of Shreveport, Louisiana (**Figure 1-1**). The installation occupies approximately 1,300 of its former 8,416 acres between State Highway 43 at Karnack, Texas and the western shore of Caddo Lake. The facility can be accessed via State Highways 43 and 134.

LHAAP was placed on the Superfund National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination began in 1990. After its listing on the NPL, the U.S. Department of the Army (U.S. Army), the U.S. Environmental Protection Agency (USEPA), and the Texas Water Commission (now the Texas Commission on Environmental Quality [TCEQ]) entered into a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §120 Federal Facility Agreement (FFA) for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property. LHAAP has been under the administrative control of the Base Realignment and Closure Division of the Army since 2003 and is Defense Environmental Restoration Account funded. The majority of LHAAP has been transferred by the U.S. Army to the U.S. Fish and Wildlife Service (USFWS) for management as the Caddo Lake National Wildlife Refuge (Shaw 2016).

LHAAP-17, an NPL site, known as the Burning Ground No. 2/Flashing Area, is a 3.9-acre site located within a heavily wooded section in the southeastern portion of LHAAP (**Figure 1-2**). The site has two 185 feet by 305 feet cleared areas, separated by a gravel access road. The site is covered with grass and scattered brush, has been graded above the surrounding terrain, and is relatively flat. LHAAP-17 was used as a burning ground from 1959 through 1980 (Plexus 2005). Bulk trinitrotoluene (TNT), photo flash powder, and reject material from Universal Match Corporation operations were burned at LHAAP-17. In 1959, the materials removed

from the former TNT Production Area (LHAAP-29) and the former TNT Waste Disposal Plant (LHAAP-32) during demolition were burned and/or flashed at LHAAP-17. The site was used as a flashing area to decontaminate recoverable metal byproducts until 1980, when it became inactive. Burning trenches were located around the inside perimeter of the previously fenced area and within the open area on the western boundary of the site (**Figure 1-3**). As each trench filled with ash, it was covered and a new trench was dug. The waste residues were reportedly removed from the trenches in 1984, and the site was allowed to revegetate (Jacobs 2001).

The ROD identified chemicals of concern (COCs) for human health and chemicals of potential ecological concern (COPECs), as shown in **Table 1-1**. The remedy selected in the ROD included excavation and off-site disposal of soil, groundwater extraction, monitored natural attenuation (MNA), and land use controls (LUCs) to maintain the remedy and prohibit groundwater use until COC concentrations are reduced to levels supportive of unlimited use and unrestricted exposure. The human health and ecological cleanup levels are shown in **Tables 1-2** and **1-3**, respectively.

Table 1-1
COCs and COPECs for LHAAP-17

Media	Chemicals of Concern (Human Health)	Chemicals of Potential Ecological Concern (COPEC)
Soil	2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (DNT), 2,6-DNT, and perchlorate	Barium, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, and 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD)
Shallow Zone Groundwater	1,1-dichloroethene (DCE), 1,2-dichloroethane, cis-1,2-DCE, trichloroethene (TCE), vinyl chloride, and perchlorate	Not applicable
Intermediate Zone Groundwater	cis-1,2-DCE, TCE, vinyl chloride	Not applicable

1.2 Selected Remedy

The selected remedy was summarized in Section 1.4 of the Final ROD (Shaw 2016) as follows:

- Contaminated soil removal with off-site disposal to protect the hypothetical future maintenance worker and ecological receptors and to eliminate the soil-to-groundwater pathway.

- Extraction and treatment of groundwater until the trigger level of 20,000 micrograms per liter (µg/L) of perchlorate is reached. The trigger level in this ROD is an interim cleanup level. Upon reaching the trigger level, the remedial action (RA) will transition

from the initial measure of groundwater extraction to the primary remedy of MNA. Reduction of the perchlorate concentration to the trigger level is anticipated to expedite MNA.

  - If the 20,000 µg/L of perchlorate level is not reached after approximately 1.5 years, a contingency remedy of in situ bioremediation will be implemented to reduce the perchlorate levels more quickly so the conditions become amenable for trichloroethene (TCE) to attenuate naturally.

- MNA to confirm protection of human health and the environment by documenting that the contaminated groundwater remains localized with minimal migration and that contaminant concentrations are being reduced to cleanup levels.

  - Performance objectives will be evaluated after two years of MNA. During those two years, monitoring will be quarterly. If MNA is found to be ineffective, a contingency remedy to enhance MNA will be implemented. If MNA is found to be effective, it will be continued, and long-term monitoring (LTM) will be semiannual for three years. In subsequent years, LTM will be annual until the next Five Year Review, and annually thereafter until recommended otherwise by the Five Year Review. The monitoring and reporting associated with this remedy will be used to track the effectiveness of MNA and will continue until recommended otherwise at the Five Year Review.

- The LUC objectives include maintaining the integrity of any current or future remedial or monitoring systems, and preventing the use of groundwater contaminated above cleanup levels as a potable water source. The groundwater treatment and MNA remedial components include a groundwater monitoring system that will be used to characterize the condition of the groundwater during the period the groundwater remedy is in place until the groundwater remediation goals are achieved, and to demonstrate achievement of the groundwater remediation goals when the groundwater remedy is complete. As a part of this groundwater remedy, the Army will maintain the remedial and monitoring systems associated with the groundwater remedies until these components of the remedy are no longer needed to achieve cleanup levels, and cleanup levels have been achieved. During the period of operation of the groundwater remedy, if any of the elements of the remedial and groundwater monitoring systems are damaged, destroyed, or become ineffective, they will be repaired or replaced with suitable components to assure that the remedial and groundwater monitoring systems are able to provide data of the quality necessary to determine the progress of and eventual completion of this component of the remedy. The actions to be taken to implement these LUC objectives and requirements will be provided through modifying

the "Comprehensive Land Use Control (LUC) Management Plan, Former Longhorn Army Ammunition Plant, Karnack, Texas" and detailed in the LUC RD.

- The LUC for prohibition of groundwater use (except for monitoring and testing) shall be implemented and shall remain in place at the Site until the COCs in soil and groundwater remaining at the site are reduced below levels that would support unlimited use and unrestricted exposure. The recordation notification for the Site, to be filed with Harrison County, will include a description of the LUCs.

- The LUC restricting land use to nonresidential shall be implemented until it is demonstrated that surface and subsurface soil and groundwater COCs are at levels that allow for unlimited use and unrestricted exposure.

  - The LUC to maintain the integrity of any current or future remedial or monitoring systems will remain in place until the levels of COCs in groundwater are met.

- CERCLA Five Year Reviews until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.

1.3 Remedial Action Objectives

The remedial action objectives (RAOs) developed for LHAAP-17 and outlined in the Final ROD (Shaw 2016) are:

- Protection of human health by preventing human exposure to the contaminated groundwater and contaminated soil;
- Protection of human health by preventing further potential degradation of groundwater from contaminated soil;
- Protection of ecological receptors by preventing exposure to the contaminated soil;
- Protection of human health and the environment by preventing contaminated groundwater from migrating into nearby surface water; and
- Return of groundwater to its potential beneficial uses as drinking water, wherever practicable.

The above RAOs recognize USEPA's policy to return all groundwater to beneficial uses, based on the non-binding programmatic expectation in the National Contingency Plan (NCP), and is consistent with the NCP regulations requiring the lead agency, the U.S. Army in this case, to establish RAOs specifying contaminants and media of concern, potential exposure pathways, and remediation goals.

Per the ROD's RAOs, and consistent with the NCP, groundwater will be returned to its beneficial use as drinking water. The cleanup levels for groundwater established in the ROD are shown in **Table 1-2**.

1.4 Document Organization

This document is composed of the following sections:

- **Section 1.0:** "Introduction" summarizes the site background, proposed remedy, and remedial action objectives.
- **Section 2.0:** "Site Characteristics" summarizes the geology and hydrogeology of the site, as well as the nature and extent of contamination.
- **Section 3.0:** "Pre-Design Investigation" summarizes the results of the Pre-Design Investigation (PDI) that form the basis for the design elements described in subsequent sections.
- **Section 4.0:** "Soil Excavation Remedial Design" describes the design basis for the planned excavation of contaminated soil.
- **Section 5.0:** "Groundwater Extraction and MNA Remedial Design" describes the extraction system and MNA design elements.
- **Section 6.0:** "Land Use Control Remedial Design" describes the proposed scope and implementation activities associated with the LUC component of the remedy.
- **Section 7.0:** "Remedial Action Work Plan" describes the tasks to implement the design for soil excavation, groundwater recovery, and MNA RAs.
- **Section 8.0:** "Post-Remedial Monitoring and Reporting" describes monitoring activities that will be used to track progress of the groundwater recovery and MNA RAs.
- **Section 9.0:** "Schedule" provides a list of activities and anticipated durations for the work plan tasks.
- **Section 10.0:** "Operation and Maintenance Procedures" describes the activities to be performed to operate and maintain the groundwater recovery system, monitoring network, and LUCs.
- **Section 11.0:** "References" provides citations for the documents used as references.

This work plan also includes the following appendices supporting the main text.

- **Appendix A** includes the Analytical Data Reports for the August 2018 soil samples collected from locations that were inaccessible during the PDI sampling event conducted in January 2018.
- **Appendix B** includes the Sample Collection Logs from the August 2018 soil sample collection event.
- **Appendix C** includes sample specification sheets for the pumps and tanks to be used as part of the groundwater extraction system.
- **Appendix D** includes a sample weekly tracking form that will be used to document groundwater recovery volumes, pumping rates, and operation and maintenance (O&M) activities for the groundwater recovery system.
- **Appendix E** includes the sample Annual LUC Compliance Checklist and Compliance Certification.

1.5 Deviations from the Installation Wide Work Plan

There are two planned deviations from the Final Installation Wide Work Plan (IWWP) (Bhate 2018b) that are described in more detail later in this document:

- **Excavation Sidewall Confirmation Samples for Small Excavations (Section 4.4)** - For small excavation areas (less than 400 square feet of floor area and sidewall height of less than 6 feet) it is proposed to collect a 4-point composite sidewall sample from such excavations by collecting a grab sample from each of the four sidewalls. The IWWP indicates that a wall samples shall be collected from every 1,000 square feet of excavation floor and from each wall. For the small excavations described, the area of the four sidewalls combined will be less than 480 square feet. If the sidewall composite sample result is above the cleanup levels, then additional grab samples will be collected from each wall to determine which direction to overexcavate. Excavation floor sampling for small excavations will be performed in accordance with the IWWP.
- **Baseline Groundwater Sampling for Perchlorate in 17WW01 and 17WW02 (Section 5.3)** – The pump inlet for the November 2017 sample from 17WW01 was at approximately 20.8 feet, which is the midpoint of the screened interval. The previously collected samples from 17WW01 in 2009 and 2010 used an inlet at 28 feet and 28.5 feet respectively. The pump inlet for the sampling of 17WW02 in 2010 was 20 feet, while an inlet depth of 17 feet was used in 2017. The baseline sample to be collected from 17WW01 prior to the installation of the extraction system will be collected with a pump inlet depth of 28 feet to match the inlet used for the 2009 and 2010 samples and 17WW02 will be sampled using a pump inlet depth of 20 feet to match the 2010 sample. This will be done to ensure consistency with the previous sampling techniques

and to allow comparable results. All other groundwater sampling planned as part of the monitoring described in this work plan will be performed in accordance with the IWWP (Bhate 2018b).

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2.0 SITE CHARACTERISTICS

2.1 Geology and Hydrogeology

The local geology at LHAAP-17 consists of silty, clayey, and sandy units of the Wilcox Group. The uppermost unit consists predominantly of silty clay-to-clay extending to depths ranging from 5 to 30 feet. Underlying this layer is a gray to light brown, fine-grained, silty-sandy unit interbedded with silty clay-to-clay lenses. The clay layers act as an aquiclude separating the Shallow Zone from the Intermediate Zone. Boring 17WW05 was drilled to a total depth of 150 feet below ground surface (bgs). In this boring, a thick, relatively homogeneous fine- to medium-grained sand was encountered from approximately 50 to 150 feet bgs and reflects the geology of the Lower Wilcox Formation.

The Intermediate and Deep Zones comprise the Wilcox Formation, which is separated from the Shallow zone by a Wilcox clay layer. With the exception of two monitoring wells, 17WW05 and 17WW16, which were completed in the Deep Zone (lower Wilcox), the remainder of the monitoring wells at the site have been completed in the Shallow Zone and Intermediate Zone (upper Wilcox). The depth of the Shallow Zone groundwater generally ranges between 10 and 35 feet bgs. The Intermediate Zone (upper Wilcox) extends below the Wilcox clay at approximately 55 feet bgs. The Deep Zone extends below the upper Wilcox to a depth of approximately 150 feet bgs based on information from well 17WW05. Groundwater elevations from two sets of co-located wells measured in November 2017 indicated that the groundwater elevation in the Intermediate Zone is generally lower than the groundwater elevation in the Shallow Zone: the groundwater elevation in Intermediate Zone well 17WW09 was lower by 0.12 foot compared to the groundwater elevation in Shallow Zone well 17WW10; similarly, the groundwater elevation in Intermediate Zone well 17WW07 was lower by 0.46 foot compared to the groundwater elevation in Shallow Zone well 17WW08. These elevations indicate that a slight downward vertical gradient is present at the site. The general groundwater flow direction depicted based on the November 2017 LHAAP-17 potentiometric data in the Shallow Zone and the November 2017 LHAAP-18/24 potentiometric data from the *Draft Quarterly Evaluation Report, 4th Quarter (October-December) 2017* (Bhate 2018a) is to the west (**Figure 2-1**), while the Intermediate Zone flow is predominantly to the north (**Figure 2-2**).

2.2 Nature and Extent of Contamination

Contamination was found in the soil and shallow zone groundwater. The COCs are toxic and, with the exception of perchlorate, carcinogenic. Principal threat waste material was initially thought to be present due to the high concentrations of perchlorate in soil. However, subsequent information confirmed that the concentrations that were present did not constitute

principal threat waste (AECOM 2016). According to the Final ROD (Shaw 2016), the maximum 2,4,6-TNT concentration in the soil is 10,000 milligrams per kilogram (mg/kg). Other explosives, 2,4-dinitrotoluene (DNT) and 2,6-DNT, have maximum concentrations of 4,000 mg/kg and 27.5 mg/kg (2018), respectively. The concentrations of 2,3,7,8-TCDD toxicity equivalence concentration and barium potentially affecting ecological receptors are 1.9×10^{-4} mg/kg and 20,500 mg/kg, respectively.

2.3 Current and Future Land Use

LHAAP is located near the unincorporated community of Karnack, Texas. Karnack is a rural community with a population of approximately 775 people. The incorporated community of Uncertain, Texas, approximate population 205, is located to the northeast of LHAAP on the edge of Caddo Lake and is a resort area and an access point to Caddo Lake. The industries in the surrounding area consist of agriculture, timber, oil and natural gas production, and recreation.

LHAAP has been an industrial facility since 1942. Production activities and associated waste management activities continued until the facility was determined to be in excess of the U.S. Army's needs in 1997. The plant area has been relatively dormant since that time. LHAAP is surrounded by a fence (except on the border with Caddo Lake) with an access gate that is locked after daylight hours, which restricts public access. The fence now represents the National Wildlife Refuge boundary. The public can access most of the facility during the day, with additional fencing and signage restricting access from some environmental sites.

The reasonably anticipated future use of LHAAP-17 is part of a national wildlife refuge. This anticipated future use is based on a Memorandum of Agreement (MOA) (U.S. Army 2004) between the USFWS and the U.S. Army. That MOA documents the transfer process of the LHAAP acreage to USFWS to become the Caddo Lake National Wildlife Refuge and will be used to facilitate a future transfer of LHAAP-17. Presently the Caddo Lake National Wildlife Refuge occupies approximately 7,100 acres of the 8,416-acre former installation. In accordance with the National Wildlife Refuge System Administration Act of 1966 and its amendments (16 USC 668dd), the land will remain as a national wildlife refuge unless there is a change brought about by an act of Congress, or the land is part of an exchange authorized by the Secretary of the Interior (Shaw 2016).

2.4 Current and Future Surface Water Use

Streams on LHAAP currently support wildlife and aquatic life. While humans may have limited access to some streams during annual hunts, there is no routine human use of streams on LHAAP. The streams do not carry adequate numbers and size of fish to support either sport or subsistence fishing. During the summer months, the streams cease flowing and/or dry up.

The streams flow into Caddo Lake. Caddo Lake is a large recreational area that covers 51 square miles and has a mean depth of 6 feet. The watershed of the lake encompasses approximately 2,700 square miles. It is used extensively for fishing and boating. Caddo Lake is a drinking water supply for multiple cities in Louisiana including Vivian, Oil City, Mooringsport, South Shore, Blanchard, Shreveport, and Bossier City.

The anticipated future uses of the streams and lake are the same as the current uses.

2.5 Current and Future Groundwater Use

Groundwater in the drinking water aquifer (250 to 430 feet bgs) near LHAAP is currently used as a drinking water source. The drinking water aquifer should not be confused with the Deep Zone groundwater, which extends only to a depth of approximately 151 feet bgs. The Deep Zone groundwater and the drinking water aquifer are distinct from each other, and there is no connectivity between the contaminated zone and the drinking water aquifer. There are five active water supply wells near LHAAP that are completed in the drinking water aquifer (**Figure 2-3**). One well is located in and owned by Caddo Lake State Park. The well is completed to a depth of 315 feet bgs and has been in use since 1935. A second well owned by the Karnack Water Supply Corporation services the town of Karnack and is located approximately two miles southeast of town. This well is completed to approximately 430 feet bgs and has been in use since 1942. The Caddo Lake Water Supply Corporation has three wells located both north and northwest of LHAAP. These wells are identified as Caddo Lake Water Supply Corporation Wells 1, 2, and 3, and all are hydraulically upgradient of LHAAP (Jacobs 2001). These wells are completed deeper than the deepest zone of contamination at LHAAP. Because of this and the large distance between these wells and LHAAP, water removal from these wells is not expected to affect groundwater flow at the site. In addition, there are several livestock and domestic wells located in the vicinity of LHAAP with depths averaging approximately 250 feet bgs.

Three water supply wells are located within the boundary of LHAAP itself. One well is located at the Fire Station; the second well is located approximately 0.35 miles southwest of the Fire Station. The third well is located 30 feet east of the USFWS administration building for the Caddo Lake National Wildlife Refuge, near the main entrance to LHAAP. The distances from these water supply wells to LHAAP-17 are approximately 2.2 miles, 2.1 miles, and 2.6 miles, respectively. The three water supply wells were completed at a depth much greater than the zone of contamination described at LHAAP-17. Two additional wells previously supplied water to the installation, but these have been plugged and abandoned. None of these three wells are currently used for drinking water at LHAAP, although they may supply water for non-potable uses.

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Although the anticipated future use of the facility as a wildlife refuge does not include the use of the groundwater at LHAAP-17 as a drinking water source, the State of Texas designates all groundwater as potential drinking water, unless otherwise classified, and consistent with 30 Texas Administrative Code (TAC) §335.563(h)(1). To be conservative, a hypothetical industrial use scenario was evaluated for risk. The future industrial scenario for LHAAP assumes limited use of groundwater as a drinking water source. The selected remedy for LHAAP-17 includes a LUC preventing groundwater use until COC concentrations are supportive of unlimited use and unrestricted exposure.

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3.0 PRE-DESIGN INVESTIGATION

A PDI was conducted between November 2017 and March 2018 in accordance with the PDI Work Plan (AECOM 2016) to collect information required for the preparation of the RD/RAWP. The Draft Final PDI Report (APTIM 2018) was submitted to the USEPA and TCEQ on September 12, 2018 and was approved with no further comments by both agencies on September 28, 2018.

3.1 Soil Investigation

During January 11-15, 2018, the soil sample collection was completed at 80 of the 93 locations identified in the PDI Work Plan (AECOM 2016). Thirteen locations in the northeastern part of the site were under water and inaccessible for sampling for barium and 2,4-DNT/2,6-DNT. Samples were collected from 12 of the 13 previously inaccessible locations on 8-9 Aug 2018. The sample from the 13th location (17SB01A) was intended to be a 7-9 feet deep vertical delineation sample; however, saturated subsurface conditions prohibited collection of the sample from that location using a hand auger, despite multiple attempts. The excavation around 17SB01A is planned for a depth of 7 feet or to the top of groundwater, whichever is shallower. If groundwater is not encountered above 7 feet, the floor sample from the excavation will take the place of the 7 to 9-foot sample that had been planned for collection. No sample will be collected if saturated conditions are encountered shallower than 7 feet. The soil sample data from the January 2018 sampling event were reported in the Draft Final PDI Report (APTIM 2018). The analytical data from the August 2018 sampling event is provided in **Table 3-1**. Analytical data reports are included as **Appendix A,** and Sample Collection Logs are provided as **Appendix B**.

The PDI identified primarily shallow explosives contamination and limited barium contamination. Areas to the north of Area H (as identified in **Figure 4-1**) in the northwest quadrant and south/east of Areas M and N (as identified on **Figure 4-1**) in the southeastern quadrant were not completely delineated by the samples collected. However, these areas approach the boundaries of the historical operations (burning and flashing pits) where surface contamination would be expected, and any concentrations in those areas exceeding the cleanup levels are unlikely to extend very deep based on the available data from those areas. Therefore, no additional sampling was conducted in these areas, and excavation confirmation sampling will be used to confirm the contaminated soil was removed. **Figure 3-1** shows the locations with concentrations of one or more COC exceeding the cleanup goal that will require excavation and the proposed excavation areas mentioned above are discussed in **Section 4.3** and shown on **Figure 4-1**.

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3.2 Aquifer Pumping Test

An aquifer-pumping test was conducted at LHAAP-17 beginning on January 19, 2018 and concluding on January 27, 2018. The aquifer-pumping test was performed following the PDI Work Plan (AECOM 2016) and consisted of 1) installation of three new piezometers; 2) period of ambient monitoring; 3) step-drawdown test; 4) constant-rate test; and 5) recovery test. The aquifer-pumping test was conducted to evaluate aquifer and pumping well properties that will provide a basis for the design (capture area, design pumping rates, piping requirements, etc.) of the groundwater recovery system specified as part the selected remedy in the ROD (Shaw 2016). Monitoring Well 17WW02 was used as the primary pumping well, and wells 17WW01 and 17WW06 were used as supplemental pumping locations at the end of the constant-rate pumping test.

The test was performed to obtain additional data for the RD as described in the PDI Work Plan (AECOM 2016). Previously, a 4-hour pumping test was conducted in 17WW01, 17WW02, and 17WW06 and indicated that the potentially sustainable pumping rates ranged from 0.89 to 1.49 gallons per minute (gpm) (AECOM 2016). The initial step test performed in January 2018 indicated that these rates could not be sustained from 17WW02. The rates in the constant-rate test ranged from 0.25 gpm in 17WW02 to 1.5 gpm in 17WW01 and 17WW06 when they were pumping. The aquifer recovered in less than 24 hours as expected. A detailed description of aquifer testing and conclusions is included in Draft Final PDI (APTIM 2018).

The Transmissivity (T), Hydraulic Conductivity (K), and Storativity (S) values calculated from the recovery tests were very consistent between all three piezometers, and generally within an order of magnitude of the values calculated from the constant-rate test data. The relatively good agreement between the two sets of calculated values provides confidence that the values are representative of the area in the vicinity of 17WW02 and may be extrapolated for use elsewhere at LHAAP-17 based on the pumping data collected from 17WW01 and 17WW06. The values calculated based on the recovery data are more consistent and should provide a good basis for designing the pumping system needed to capture and remove the high concentrations of perchlorate present in groundwater in the vicinity of 17WW06 in accordance with the selected remedy in the ROD. Because the late term pumping data from 17WW06 indicate that it may be capable of producing greater than 1.5 gpm, careful consideration has been given to the design of the pumping system described in **Section 5.0**.

4.0 SOIL EXCAVATION REMEDIAL DESIGN

The design elements of the excavation are provided in the following sections. The details of the implementation of the design are included in **Section 7.0**.

4.1 Design Criteria

The soil design criteria define the goals to be achieved and are based on the RAOs of protection of human and ecological receptors from contaminated soil and the protection of human health by preventing further potential degradation of groundwater. The ROD identified chemical COCs for human health and COPECs as shown in **Table 1-1**. The soil cleanup levels for Human Health Risk and Ecological Risk in Soil (EcoPRGs) included in the ROD are shown in **Tables 1-2** and **1-3**. The design for soil includes excavation of the contaminated soil until the cleanup levels are attained or groundwater is encountered. If the contamination is present at or below groundwater level, excavation will be terminated at the depth where saturated conditions are encountered.

4.2 Performance Objective

The performance objective is to remove the contaminated soil above the cleanup levels. Confirmation samples will be collected and analyzed for the COCs or COPECs after excavation to verify the contaminated soils were removed and cleanup levels were attained. Soil concentrations in several samples exceeded the cleanup levels for human and/or ecological receptors. The soil samples exceeding the human health and ecological cleanup levels for the COCs and COPECs are shown on **Figure 3-1**.

4.3 Excavation Area

The proposed excavation area to address both human health and ecological receptors is shown on **Figure 4-1**. The excavation area was developed by extending the limit (vertically and horizontally) to sample locations that had results below the COC or COPEC cleanup levels based on the data in the Draft Final PDI Report (APTIM 2018), the August 2018 soil sample results, and the historical data. The estimated horizontal area is depicted on the figures. The excavation depths anticipated to remove the contaminated soil vary from 2 to 7.5 feet bgs at various locations within the footprint of LHAAP-17. The groundwater elevation typically varies from 7 to 9 feet bgs. As discussed in **Section 3.1**, the excavation area is not fully delineated, but approximately 5,300 in-place cubic yards (CY) of soil will be excavated.

In most areas, soil will be excavated from the entire area to a depth of 2.5 feet bgs to 3 feet bgs. Isolated samples had contamination detected deeper than 3 feet, but were clean at 7 feet bgs. In these excavation areas, the excavation floor will be sloped from the 3 foot to the 7 foot

depth. In areas where the sidewall height of the deeper excavation area would be greater than 4 feet, the excavation walls will be benched.

Confirmation samples will be collected to define the final excavation limits. If contamination is present in a confirmation sample, the excavation limits will be extended in increments of 1 foot vertically and 2 to 5 feet horizontally until confirmation samples are below the applicable human health cleanup levels or saturated conditions are encountered. Areas being excavated for ecological exceedances will be terminated at 2 feet bgs vertically because deeper soil will not impact ecological receptors; however, the ecological area excavations will be extended horizontally if wall samples indicate contamination is present above the ecological cleanup levels.

4.4 Confirmation Sampling

Each confirmation sample will be a 5-point composite soil sample collected from every 1,000 square feet of the excavation floor area and of each sidewall, in accordance with the IWWP (Bhate 2018b). However, a deviation from the 5-point composite methodology is proposed to allow the use of existing soil samples to define the excavation limits. The proposed excavation extent shown on **Figure 4-1** has been established to allow the use of the existing soil samples as confirmatory wall or floor samples where possible. **Figure 4-2** shows the existing samples that will be used as confirmation samples for the proposed excavation. **Table 4-1** summarizes the sample locations to be used for each excavation area and the additional confirmation samples from each area that will be collected to provide for adequate sampling of the excavation area floors and sidewalls in accordance with the IWWP (Bhate 2018b).

The following proposed sampling procedure for small excavation areas (less than 400 square feet of floor area and sidewall height of less than 6 feet) is a deviation from the IWWP. It is proposed to collect a 4-point composite sidewall sample from such excavations by collecting a grab sample from each of the four sidewalls. If the sidewall composite sample result is above the cleanup levels, then additional grab samples will be collected from each wall to determine which direction to overexcavate. Excavation floor sampling for small excavations will be performed in accordance with the IWWP.

Based on the initial excavation limits shown on **Figure 4-1** and the sampling summarized on **Table 4-1**, approximately 17 confirmation samples will be collected from the floors, and approximately 26 confirmation samples will be collected from the sidewalls of the excavation areas. If the confirmation sample is above the cleanup level, additional soil will be removed (5 feet laterally and 1 foot vertically). After each over-excavation, additional confirmation samples will be collected from the excavation floor and/or wall(s) as needed. This process of over-excavation and collection of additional confirmation samples will continue until the cleanup level area attained or until groundwater is encountered.

In the event that groundwater is encountered and a floor sample cannot be collected, a linear 5-point composite sample will be collected from each excavation sidewall just above the groundwater interface to represent the floor area above the groundwater. If the linear 5-point composite sidewall sample is above the cleanup level, then additional excavation of the sidewall will be conducted to the groundwater interface depth, and over-excavation step outs and confirmation sampling would continue until the confirmation sample results are below the cleanup levels. The confirmation samples will confirm that the vadose zone soil identified as exceeding the cleanup levels would be removed.

4.5 Waste Characterization and Disposal

The excavated soil will be disposed at an off-site landfill. Waste characterization samples will be collected at a rate of one sample for every 1,000 cubic yards of excavated soil to characterize the waste. It is anticipated that soil will be classified as non-hazardous. Samples will be analyzed for the analytes required by the selected waste disposal facility.

4.6 Backfill and Site Restoration

Following the receipt of clean confirmation samples for a given excavation area, clean fill dirt will be placed in the excavation and compacted with the backhoe/excavator bucket to prevent settling. The fill dirt will be suitable for future vegetation growth. Borrow source material will be considered clean if VOC, explosives, and perchlorate are below the TCEQ RRS2 MSCs for industrial use and metals are below the ecological cleanup levels. Approximately 7,400 CY of fill dirt will be brought on site. Borrow source samples will be collected at a rate of one per 1,000 cubic yards of borrow soil. The site will be reseeded with a native grass and wildflower mix with guidance from USFWS.

4.7 Other Design Considerations

Several of the bridges at LHAAP have weight limits. Routes for trucks filled with waste soil as well as for trucks bringing clean soil from borrow sources will be selected with coordination from USFWS. Additional gates may need to be unlocked to allow access to and from LHAAP from another gate besides the main gate in Karnack to avoid bridges where weight limits may be exceeded with loaded trucks.

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5.0 GROUNDWATER EXTRACTION AND MNA REMEDIAL DESIGN

The design elements for the groundwater extraction are provided in the following sections. The details of the implementation of the design are included in **Section 7.0**.

5.1 Design Criteria

The groundwater design criteria define the goals to be achieved and are based on the RAOs of protection of human health from contaminated groundwater, of protection of human health and the environment by preventing contaminated groundwater from migrating into nearby surface water, and if practicable, return groundwater to its potential beneficial use as drinking water. The ROD identified COCs for groundwater, as shown in **Table 1-1**. The groundwater cleanup levels for Human Health Risk from the ROD are shown in **Table 1-2**. The design for groundwater includes extraction, MNA, and a contingency remedy, if needed.

5.2 Performance Objective

The performance objective is to extract contaminated groundwater in the Shallow Zone for 18 months to remove concentrations of perchlorate exceeding 20,000 µg/L. The current concentrations and perchlorate plume in the shallow groundwater zone are shown on **Figure 5-1** and **Table 5-1**. If the perchlorate concentration in each of the wells has dropped below 20,000 µg/L at the end of the 18-month extraction period, MNA will be implemented until the groundwater COCs have attained the cleanup level. If the trigger value has not been obtained after the extraction period, a contingency remedy will be implemented to treat the contaminated groundwater in situ.

5.3 Groundwater Extraction Design

The groundwater extraction system will include groundwater recovery pumps installed in two extraction wells located within the perchlorate and TCE groundwater plumes (17WW02 and 17WW06). Baseline groundwater samples will be collected from 17WW01, 17WW02, and 17WW06 prior to beginning the system construction. The sample from 17WW01 will be collected with a pump inlet depth of 28 feet and 17WW02 will be collected with a pump inlet depth of 20 feet to be consistent with the 2009 and 2010 samples collected from those locations, which contained perchlorate concentrations exceeding 20,000 µg/L. As discussed in Section 1.5, the sample collection at 17WW01 and 17WW02 will be a deviation from the IWWP. The remaining groundwater samples will be collected in accordance with the IWWP (Bhate 2018b). If the perchlorate concentration in well 17WW01 is greater than 20,000 µg/L, 17WW01 will be outfitted with a pump and used as an extraction well along with 17WW02 and 17WW06. The extracted groundwater will be piped to the existing 4-inch conveyance line

from LHAAP-16 to the groundwater treatment plant (GWTP) for treatment, prior to discharge to Harrison Bayou. The design in this document focuses on extracting and conveying the groundwater to the existing line and not on the treatment at the GWTP. The GWTP process is designed to treat groundwater impacted with perchlorate and volatile organic compounds and has the capacity to treat the contaminants from LHAAP-17.

5.4 System Components

The pumps in the extraction wells will be pneumatically operated using compressed air supplied by a compressor to be installed at the site. The decision to use pneumatic pumps was driven by the range of flow rates potentially expected in the two wells, the distance of the site from electrical power lines, and the ability to easily avoid damage to the pumps, which could occur if electric submersible pumps were used and ran dry.

Figure 5-2 is the process flow diagram that depicts the groundwater extraction from two wells. The following subsections provide more details about the pumps and other components selected.

5.4.1 Extraction Pump Selection

The proposed pneumatic pumps are made of fiberglass body and internal parts consisting of stainless steel and polyvinylidene difluoride (PVDF) which are compatible with the COCs present in the groundwater. The pump specifications are included in **Appendix C** of this Plan. The pneumatic pumps operate on compressed air and are capable of extraction rates ranging from 0 to 5 gpm, which will meet the pumping rates expected from these two wells. These pumps expel a known volume of water with each cycle and contain cycle counters to record the quantity of groundwater extracted from each well within a given time period. The existing stickup well boxes will be removed, and the pump controller and connecting piping at each wellhead will be installed in steel well vault measuring approximately 4 feet by 4 feet. A compressor will be connected to an electrical drop near the entrance of the site along Avenue Q, and compressed air lines and water piping will be installed in a trench to the wellheads to operate the pumps. The pump and other equipment installation details are described in **Section 7.0** of this Plan.

The constant rate pumping test performed for the PDI pumped well 17WW02 at a rate of 0.25 gpm for approximately 48 hours. Steady state drawdown levels were achieved in the pumping well (8.72 feet of drawdown), as well as three nearby piezometers prior to initiating pumping in 17WW01 and 17WW06. At the time steady state was achieved, the drawdown at a distance of 90 feet from the pumping well was approximate 0.25 feet, but the drawdown at a well approximately 150 feet from the pumping well could not be distinguished from background fluctuations. Therefore, the radius of influence for pumping 17WW02 at a rate of

0.25 gpm is conservatively estimated at approximately 100 feet. The pumping rate was limited during the pumping test by the need to avoid running the pump dry and the placement of transducers several feet below the pump. The construction of 17WW02 will allow at least five additional feet of drawdown, which will allow a flow rate higher than 0.25 gpm to be sustained. The pneumatic pumps proposed for use cannot be damaged by running the well dry and can fully dewater the well to maximize the cone of depression around it. The calculations shown on **Table 5-2** estimate that 17WW02 will maintain a pumping rate of 0.4 gpm when fully drawn down, and **Figure 5-3** shows a 125 foot estimated radius of influence for the higher pumping rate.

The second proposed extraction well, 17WW06, was operated at a pumping rate of 1.5 gpm near the end of the pumping test, and the final drawdown was 4.09 feet. The pumping of 17WW06 and 17WW01 showed measurable drawdown at piezometer locations 150 to 180 feet from the wells, indicating that the radius of influence when pumping in the 1.25 to 1.5 gpm range was at least 150 feet. The construction of 17WW06 will allow at least another 6.5 feet of drawdown. Therefore, the calculation on **Table 5-2** estimate a pumping rate of 2.5 gpm for 17WW06 and **Figure 5-3** shows an estimate radius of influence of 250 feet.

Monitoring Well 17WW02 may also be used as an extraction well based on the outcome of the baseline sampling. 17WW02 was pumped at a rate of 1.25 gpm at the end of the pumping test and the final drawdown was 11.31 feet. Based on a pumping rate of 1.5 gpm, the radius of influence for 17WW01 is estimated to be 200 feet, as shown on **Figure 5-3**. The calculation on **Table 5-2** uses the estimated pumping rate of 1.5 gpm for 17WW01.

It should be noted that various empirically derived formulae for estimating radius of influence provide significantly higher estimated radii of influence for the wells based on the hydraulic conductivity, storativity, and transmissivity values calculated from the pump test. The radii of influence used for 17WW02 and 17WW06 on **Table 5-2** and **Figure 5-3** are conservatively estimated for this RD based on the observed drawdown measured during the pumping test and will be adequate to capture nearly the full extent of the perchlorate plume exceeding 17 µg/L as depicted on **Figure 5-3**. The aquifer pumping test results were discussed in **Section 3.2** of this document.

5.4.2 Extraction/Discharge Piping and Temporary Storage of Groundwater

The groundwater extracted from the extraction wells will be temporarily stored in a 2,500-gallon high density polyethylene pipe (HDPE), double wall holding tank located at LHAAP-17. The holding tank will be placed and anchored to a concrete pad adjacent to the compressor pad. Details of the holding tank are included in **Appendix C** of this Plan. The 1-inch diameter HDPE extraction piping from the two wells will be connected to the holding

tank. The piping will be buried underground. From the holding tank, 1-inch polyvinyl chloride piping will run above ground to the transfer pump, and this piping will be insulated or heat traced for freeze protection. The 1-inch PVC piping from the transfer pump will be buried and tapped into the existing 4-inch PVC conveyance pipe from LHAAP-16 to the GWTP. If LHAAP-16 is no longer in operation, the conveyance line to the GWTP may be cut and blind flanged. If operation is still ongoing at LHAAP-16, appropriate valves will be installed on the LHAAP-16 conveyance line to prevent any potential backflows. As shown on **Figure 5-2**, the existing high-level sensor in the GWTP equalization tank (currently used to shut down the LHAAP-18/24 wellfield) will be used to trigger shutoff of the transfer pump to avoid overfilling the equalization tank. The holding tank at LHAAP-17 will also be equipped with auto shutoff equipment to shut down pumping from the extraction wells to prevent overfilling the holding tank. The extracted groundwater from the holding tank will be transferred to the GWTP by a transfer pump activated by level sensors. The piping, holding tank, and other appurtenances installation details are described in **Section 7.0**.

5.5 Groundwater Monitoring During Extraction

Remedial Action Operation (RA-O) sampling will commence once extraction begins. Water from 17WW01, 17WW02, and 17WW06 will be sampled and analyzed for perchlorate prior to beginning extraction to determine if 17WW01 will be needed as an extraction well (if the perchlorate concentration exceeds 20,000 µg/L). Sampling of water from 17WW01, 17WW02, 17WW03, 17WW06, and 130, will be conducted monthly for the first 6 months and then quarterly for the next 12 months of the extraction period. Data from the samples collected semiannually from MW-18 and MW-19 as part of the LHAAP-18/24 monitoring will be used to evaluate possible impacts from the extraction on the LHAAP-18/24 plume. The remaining LHAAP-17 network wells will be gauged for the initial baseline elevation and quarterly to allow for evaluation of the capture radius of the extraction system. Once the 18-month extraction period is completed, quarterly MNA monitoring will be initiated as part of the RA-O sampling. Following consultation with the USEPA and TCEQ, the groundwater extraction system will be shut down at the conclusion of the 18-month period.

5.6 Post Extraction MNA Monitoring Design

Upon achieving the target perchlorate concentration in the sampled wells and shutting down the extraction system, the MNA monitoring program will begin with quarterly sampling of monitoring wells selected for the monitoring network for two years. The monitoring network is discussed in **Section 8.2**. Following two years of quarterly monitoring, an MNA evaluation will be performed to determine if the remedy is successful. If so, monitoring will continue semiannually for three years and then annually thereafter. If MNA is unsuccessful, a contingent remedy may be implemented via an Explanation of Significant Differences (ESD) to the ROD.

5.7 Contingency Remedy

If the target perchlorate concentration of 20,000 µg/L is not met in the sampled wells after 18 months of extraction, a contingent remedy may be implemented via an ESD to the ROD.

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6.0 LAND USE CONTROL PLAN

The U.S. Army or its representative will be responsible for LUC implementation and certification, reporting and enforcement. The U.S. Army will address the LUC problems within its control that are likely to impact remedy integrity and will address problems as soon as practicable. Per the Final ROD (Shaw 2016), the LUCs' performance objectives are to:

- Prohibit the use of groundwater contaminated as a potable water source;
- Restrict land use to nonresidential; and
- Maintain the integrity of any current or future remedial or monitoring systems.

The implementation, maintenance, and inspection requirements associated with each of the performance objectives that comprise this LUC RD are described below. The proposed actions to be taken to implement the LUC objectives during the RA phase are described in **Section 8.0**. The implementation activities, as well as ongoing maintenance, monitoring, and reporting requirements will be presented in the Remedial Action Completion Report (RACR), as the final LUC RD. Upon regulatory review and concurrence with the final LUC RD, it will be included as part of the Comprehensive LUC Management Plan.

For portions of the Site subject to land use controls that are not owned by the Army, the Army will monitor and report on the implementation, maintenance, and enforcement of land use controls, and coordinate with federal, state, and local governments and owners and occupants of properties subject to land use controls. The Army retains responsibility for ensuring that the remedy remains protective of human health and the environment.

6.1 LUC Implementation

The actions required to implement the LUCs for LHAAP-17 are described below. The first of these, the initial notice of LUCs was completed on December 8, 2016. The December 8, 2016 notice letters that were sent to relevant officials (U.S. Army 2016) included a preliminary LUC boundary. The proposed LUC boundary for the groundwater use restriction is shown in red on **Figure 6-1**. The LUC boundary for the non-residential site use will be the "Site Boundary" shown in blue on **Figure 6-1**. The following actions will be undertaken to implement the LUCs for LHAAP-17:

- Finalize the boundary for the LUCs as a part of the remedial action.
  - Revise the boundary, if necessary, based on groundwater sampling results. The final boundary of the groundwater LUCs (prevent the use of groundwater contaminated above cleanup levels as a potable water source and prohibit access to the contaminated groundwater except for environmental monitoring and testing

only); the remedial or monitoring system LUCs (maintain the integrity of any current or future remedial or monitoring systems); and the nonresidential land use LUC (restrict land use to nonresidential) will be reviewed during RA activities after an evaluation of the monitoring data has been completed and revised if necessary.

  - Survey the groundwater use and land use restriction LUC boundaries. The boundaries will be finalized after concurrence by USEPA and TCEQ, and will be surveyed by a State-licensed surveyor. A legal description of the surveyed areas will be appended to the survey plat.

- Record the LUCs in Harrison County. The LUC plat, legal description, and LUC restriction language will be recorded in the Harrison County Courthouse in accordance with TAC Title 30, §335.566.
- Notify the Texas Department of Licensing and Regulation of the groundwater LUCs. The Texas Department of Licensing and Regulation will be notified of the groundwater restrictions, which include the prohibition of water well installation for any purpose other than environmental monitoring and testing without prior approval from the Army, the USEPA, and the TCEQ. The survey plat, legal boundary, and description of the groundwater restriction LUCs, in conjunction with a locator map, will be provided in hard and electronic copy.
- Provide notice after finalizing LUC boundary as part of the RA. The notice will consist of a brief description of the contaminants in groundwater and soil, a written description of the LUCs and a figure depicting the revised LUC boundaries. The notices will be sent to federal, state, and local officials including: U.S. Senators, U.S. Congressman, State Senator, State Representative, Harrison County Judge, Harrison County Commissioner Precinct 1, City of Uncertain Mayor, and Karnack Water Supply Corporation Board Members. Notice will also be sent to the Caddo Lake National Wildlife Refuge Manager.
- Periodically transmit the notice to federal, state, and local governments involved at this site and the owners and occupants of the properties subject to those use restrictions and LUCs. The transmittal will coincide with each Five Year Review and will be documented in the report.

6.2 Maintenance and Monitoring Requirements

The LUCs will be maintained in place as follows:

- The LUCs restricting the use of groundwater to environmental monitoring and testing only and the LUC restricting land use to nonresidential will remain in place until the levels of COCs (i.e., including all hazardous substances, pollutants, and contaminants found at the Site at cleanup levels as listed in **Tables 1-2 and 1-3**) in surface and subsurface soil and groundwater allow for unlimited use and unrestricted exposure;

- The LUC to maintain the integrity of any current or future remedial or monitoring systems will remain in place until groundwater cleanup levels of COCs (i.e., including all hazardous substances, pollutants and contaminants found at the Site at cleanup levels as listed in **Table 1-2**) are met; and,

- The LUC prohibiting groundwater use (except for environmental monitoring and testing) as a potable source will remain in place until the levels of COCs (i.e., all hazardous substances, pollutants, and contaminants found at the Site at cleanup levels as listed in **Tables 1-2 and 1-3**) in soil and groundwater allow for unlimited use and unrestricted exposure.

Remedial or Monitoring System LUCs include physical components that require repair and maintenance. These are described in **Section 10.0.** The RAO and Extraction System Inspection and Maintenance Checklists is provided in **Appendix D.**

The administrative maintenance required to ensure the LUCs remain in place and effective until the cleanup levels of the COCs are at levels that allow unrestricted use and unlimited exposure are:

- Annual field inspections of the site to confirm that no violations of the LUCs have occurred. Documentation of the inspection will be included in the Inspection and Maintenance Checklist (see **Appendix D).**

- Annual certifications that no LUC-restricted activities have been authorized and that site conditions and use are consistent with the LUCs. The Certification Form is presented in **Appendix E).**

- Periodic transmittal of a LUC Notice to federal, state, and local authorities and to owners and occupants of LHAAP-17. The notice will include the groundwater and soil (surface and subsurface) contamination and any land use restrictions referenced in the ROD, a written description of the LUCs and a figure depicting the LUC boundaries. The transmittal will coincide with each Five Year Review and will be documented in the report.

- The final LUC RD appendix of the RACR will be added to the Comprehensive LUC Management Plan and the plan will be provided to the owner or occupant of LHAAP-17.

The U.S. Army will address LUC problems within its control that are likely to impact remedy integrity and shall address problems as soon as practicable.

6.3 LUC Inspection and Monitoring

Upon finalization of this LUC RA, the amended LUC boundary map and legal description recordation will be inserted into the Comprehensive LUC Management Plan for LHAAP. The Comprehensive LUC Management Plan figure and table will be updated to reflect the inclusion of LHAAP-17.

Beginning with finalization of this RD/RAWP and approval of the Inspection and Maintenance form and the Annual Certification Form, the U.S. Army will undertake inspections and certify continued compliance with the LUC objectives. The U.S. Army, or the transferee after transfer, will retain the LUC Inspection and Certification documents in the project files for incorporation into the Five Year Review reports, and these documents will be made available to USEPA and TCEQ upon request. In addition, should any violations be found during the certification, the U.S. Army will provide to USEPA and TCEQ, along with the document, a separate written explanation indicating the specific violations found and what efforts or measures have or will be taken to correct those violations. The need to continue inspections and certifications will be revisited at Five Year Reviews.

7.0 REMEDIAL ACTION WORK PLAN

7.1 Field Activities

This section describes the remedial action field activities planned at the LHAAP-17. Prior to initiation of the field activities performed as part of this RD/RAWP, the regulators will be notified at least 10 days in advance. Site-specific activities are described in associated subsections. The field activities to be conducted under this Work Plan are outlined below:

- Mobilization and Site Setup
- Surveying
- Soil Excavation and Disposal
- Confirmation Soil Sampling
- Backfilling and Site Restoration
- Groundwater Extraction System Installation
- Waste Management
- Decontamination
- Site Restoration

In general, the field activities will be conducted in accordance with the IWWP for LHAAP (Bhate 2018b). To the degree possible, excavation activities and groundwater extraction system construction will occur concurrently. However, because excavation is planned for the area around 17WW02, the groundwater extraction piping and control connections to 17WW02 will not be completed until after the excavation has been backfilled in that area.

7.1.1 Mobilization and Site Setup

Prior to the mobilization of subcontractors to LHAAP sites, work locations for overhead and ground level accessibility will be evaluated. In areas that have excessive vegetation and/or tree growth, a backhoe or other appropriate earthmoving equipment will be used to clear the areas to allow equipment access. After coordinating with underground utility locators for utility clearances, excavation locations and areas that require surface soil removal will be located and staked. Utility location and clearance for intrusive activities will be conducted in accordance with Section 3.1 of the IWWP (Bhate 2018b).

Appropriate personnel, subcontractors, and equipment necessary to perform specific task(s) will be mobilized to the site. A permanent decontamination station is located at the on-site LHAAP-18/24 GWTP and can accommodate large equipment. Temporary decontamination

pads will be constructed as needed at approved on-site locations to decontaminate equipment and prevent cross-contamination between sites. Wash water will be contained and transported to the GWTP for disposal when necessary.

Improvement of the site access road using gravel or other materials to reduce the slopes may be performed to allow trucks and heavy equipment to enter and exit the site safely. USFWS will be consulted regarding any improvements to minimize impact to the surrounding terrain to the degree possible.

7.1.2 Surveying

During the excavation, the locations of soil confirmation samples and limits of excavation will be surveyed using global positioning system (GPS) equipment. Use of GPS equipment will be coordinated with USACE in accordance with Section 3.3 of the IWWP (Bhate 2018b). A professional land surveyor licensed in the State of Texas will survey the final horizontal excavation limits. The new vertical elevations of the top of casing for the wells modified to be used as pumping wells (17WW02 and 17WW06) will be based on the North American Vertical Datum of 1988 and will be surveyed to the nearest 0.01 foot.

7.1.3 Soil Excavation and Disposal

The limits and plans for excavation are described in **Section 4.0** of this Plan. Excavation of the soil generally consists of preparing the site, excavating the soil, transporting and disposing the soil, collecting confirmation samples, surveying the excavation limits, backfilling, and restoring the site. Excavations performed under this remedial action are expected to be less than one acre in size and are not subject to the storm water pollution prevention requirements of Chapter 26 of the Texas Water Code and TCEQ General Permit TXR15000. However, best practices (silt fencing, berms, etc.) will be used where appropriate to prevent excess runoff of sediment from the excavation and stockpile areas.

7.1.3.1 Site Preparation

The areas to initially be excavated will be established prior to mobilization of the excavation personnel. A GPS will be used to delineate and mark the excavation area shown on **Figure 4-1**. The potential limits of excavation will then be physically marked with survey stakes, pin flags, paint, or other appropriate marking. Clearing of the vegetation in the excavation area will largely be conducted using conventional equipment. A temporary decontamination station may be constructed on site as needed.

The southwestern portion of the site will be cleared for construction of a temporary soil staging/stock pile area. A temporary staging area consisting of berm with polyethylene sheeting will be constructed for stockpiling soil prior to collecting waste characterization and off-site transport and disposal.

7.1.3.2 Excavation and Soil Handling

After the initial excavation limits are established, excavation will begin. Areas where the excavation depths will exceed four feet will be benched for safety reasons for the persons entering the excavation area. Vertical excavation will stop if groundwater is encountered.

At excavation areas with sufficient soil analytical results from the Draft Final PDI (APTIM 2018), the selected disposal facility may evaluate the results for characterization of the waste and provide pre-excavation acceptance of the soil from these select areas. Pre-excavation acceptance will allow direct loading of contaminated soil and avoid staging and double-handling of material. In these instances, the soil will be removed from the excavation and placed directly in transport trailers or dump trucks for immediate transport to the disposal facility. Licensed transporters will be used to haul the excavated soil to the pre-approved landfill for non-hazardous disposal. The excavated soil may be staged on plastic sheeting adjacent to the excavation while awaiting loading. The excavated soil stockpile will be protected from rainfall runoff and erosion by covering it with plastic sheeting.

Composite samples will be collected from staged material at a rate of 1 sample per 1,000 CY and analyzed for the necessary analytes to obtain acceptance at the selected disposal facility. Each composite sample will consist of equal parts of five samples collected at evenly spaced locations within the stockpile. The fully-characterized excavation stockpile soil will be loaded onto dump trucks and removed from the site for proper disposal in accordance with state and federal regulations. Loading of trucks will be coordinated with USFWS to ensure that load ratings for bridges along the haul route out of the refuge are not exceeded.

7.1.3.3 Confirmation Soil Sampling

Confirmation soil sampling will be conducted concurrently with excavation and will document that the remaining soil meets the established cleanup levels as shown in **Tables 1-2** and **1-3**. After the initial excavation, confirmation samples will be collected from the sidewalls and floor of the excavation in the areas where existing samples are not available for use as confirmation samples. The confirmation samples will be tested for the ecological or human health contaminants being addressed for each excavation area (**Figure 4-1)**. Excavation will continue until concentrations in the soil are less than the site-specific cleanup levels.

When existing sample data are not available for use as confirmation samples, additional composite samples will be collected to ensure that every 1,000 square feet of floor or each sidewall is representatively sampled. Five-point composite soil samples will be collected in accordance with the IWWP (Bhate 2018b). As described in **Section 4.4**, in small areas a composite wall sample may deviate from the IWWP and will be collected by combining discrete samples collected from each of the four walls.

GPS coordinates of each discrete sample location that comprises the composite confirmation sample will be collected. Vertical wall height will be manually measured and recorded. Each sample location will be numbered sequentially in order of collection, labelled on a map, and identified using the following nomenclature:

17WLXXX-ZZ-MMDDYY or 17FLXXX-ZZ-MMDDYY

The number 17 represents the site (LHAAP-17); WL indicates a sidewall sample, while FL indicates a floor sample; XXX represents the unique sample number; ZZ indicates excavation sidewall height or the average depth below ground surface of the excavation floor; and MMDDYY is the date of sample collection.

If contaminants are detected above their cleanup levels during the confirmation sampling, the area will be over-excavated at least one additional foot deeper or 2 to 5 additional feet sideways. The extent of the over-excavation (2 to 5 feet) will consider the concentrations detected in the sidewall sample, and the floor over-excavation will consider the anticipated depth to groundwater. This will continue until confirmation samples demonstrate the contaminants remaining in the soil are below their cleanup level or until groundwater is encountered. The areas excavated for ecological receptors will not be over-excavated vertically, but may be stepped out horizontally.

In the event that groundwater is encountered and a floor sample cannot be collected, a linear 5-point composite sample will be collected from each excavation sidewall just above the groundwater interface to represent the floor area above the groundwater. If the linear 5-point composite sidewall sample is above the cleanup level, then additional excavation of the sidewall will be conducted to the groundwater interface depth, and over-excavation step outs and confirmation sampling would continue until the confirmation sample results are below the cleanup levels. The confirmation samples will confirm that the vadose zone soil identified as exceeding the cleanup levels would be removed.

7.1.3.4 Backfilling and Site Restoration

The backfill operations will proceed after excavation confirmation samples are clean for a definable area. The excavation areas will be backfilled with fill material that is certified to meet the site-specific cleanup levels. If the soil is unstable due to the moisture from the adjacent tributaries/ditches and saturated soil from rain events, the bottom of the excavation will be stabilized with an appropriate product that will not adversely impact the soil pH prior to placing the backfill. The backfill will be placed in 1-foot lifts to allow proper compaction with a backhoe/excavator bucket. After backfilling is complete, the area will be graded, with a mound approximately one foot above finished grade to allow for some soil settling without creating a depression and positive drainage. The top six inches will have a soil that will be

suitable for vegetative growth. The surface will be reseeded with a native grass and wildflower seed mixture selected in coordination with USFWS.

7.2 Groundwater Extraction System Installation

The groundwater extraction system mainly consists of extraction wells, extraction pumps, extraction piping, holding tank, and discharge lines to GWTP. A power drop from existing electric service lines is planned near the entrance of LHAAP-17. If the power drop is not viable, a diesel power generator would be used. The overall groundwater recovery system is shown on **Figure 5-2**.

7.2.1 Extraction Pump Installation

Prior to the extraction pump placement in the wells, groundwater levels will be measured to determine the depth of installation of the pump to get maximum extraction rate. In general, the bottom of the pump will be set at least two feet from the bottom of the well. The pump will be equipped with cycle counters to measure the amount of groundwater recovered from each well. The wellhead assembly will be housed in a 4-foot by 4-foot steel vault and will be equipped with a sample port to allow collection of a sample directly from water produced by the well. The extraction pumps will be operated by compressed air supplied by a compressor located on site. The air compressor will be housed in a building to protect from the elements. The air compressor will be powered by a generator or an electric drop from the power lines along Avenue Q near the entrance to the site.

7.2.2 Extraction/Discharge Piping

The extraction piping will be of SDR 11 HDPE and will be buried at least 18 inches below ground. A walk behind trencher will be used to lay the piping underground. A certified HDPE pipe welding technician will perform the welding of the pipe. The trenches will be backfilled and compacted once the pipe is placed. The extraction piping from each well will be connected to manifold and to the holding tank. The discharge pipe from the holding tank will be PVC piping and will run above ground to the transfer pump before being buried and connected to the existing conveyance line coming from LHAAP-16 feeding into the LHAAP-18/24 GWTP. Backflow preventers will be installed as needed to prevent cross flow to or from LHAAP-16. The piping layout is shown on **Figure 7-1**.

7.2.3 Holding Tank

The 2,500-gallon dual wall HDPE tank will be installed and anchored to concrete pad approximately 10 feet by 10 feet by 4 inches thick, with two layers of weld mesh. The holding tank will be equipped with an auto shut off system to prevent overflow of the tank. The tank will also have a transfer pump activated by level sensors to transfer water to the GWTP. The location of the tank is shown on **Figure 7-1**.

7.3 Waste Management

Waste generated during the course of the project that include waste water, soil piles, personal protective equipment, sampling equipment, and miscellaneous trash will be managed as per Section 3.7 of the IWWP (Bhate 2018b).

7.4 Decontamination

Decontamination of equipment will be performed as per A1 SOP Appendix A of the IWWP (Bhate 2018b).

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8.0 POST-REMEDIAL MONITORING AND REPORTING

8.1 Groundwater Extraction Monitoring

Following installation of the groundwater extraction system, monitoring wells 17WW01, 17WW02, 17WW03, 17WW06, and 130 will be sampled monthly for the first 6 months and then quarterly for 12 months during the 18-month extraction period. The samples will be analyzed for perchlorate by EPA Method 6850 to evaluate progress of the extraction. Upon completing the 18-month extraction period, the system will be shut down, dismantled, and removed, and the MNA monitoring program described below will begin (if the 20,000 µg/L has been achieved) as part of the RA-O sampling.

8.2 RA-O Monitoring Network

The RA-O monitoring network to be used to evaluate the performance of the LHAAP-17 MNA remedy will be selected based on the initial sampling of the network of wells shown in **Table 8-1**. The wells on **Table 8-1** include 14 shallow wells with detected concentrations of COCs and key unimpacted wells upgradient, cross-gradient, and downgradient from the perchlorate and VOC plume areas. Three intermediate zone wells closest to the plume area are also included to allow detection of vertical migration of COCs. Because intermediate zone contamination was not present in the 2017 sampling and deep zone contamination has not been previously detected, monitoring of the deep zone will not be necessary for the RA-O monitoring program. The two deep zone wells will be sampled for the initial sampling event following completion of the extraction period and for each Five Year Review. Following the initial sampling event, the monitoring network may be modified based on the sampling results with regulatory concurrence. All wells with concentrations of one or more COCs exceeding the cleanup goals will be analyzed for the site COCs (VOCs and perchlorate) as well as MNA parameters as shown in the example network in **Table 8-2** (4 wells based on 2017 analytical results). The remaining wells selected for the network will be analyzed only for the groundwater COCs. The initial monitoring network wells are shown on **Figure 8.1**.

8.3 Groundwater Sampling

Groundwater sampling events performed for LHAAP-17 will consist of the following:

- A baseline monitoring event from all LHAAP-17 COC-impacted wells (17WW01, 17WW02, 17WW03, 17WW06, and 130) conducted prior to the initiation of groundwater extraction and monthly for 6 months, followed by quarterly sampling for the next 12 months

- RA-O/MNA monitoring to be conducted quarterly for two years beginning upon completion of the groundwater extraction and used to evaluate the performance of the MNA remedy

- RA-O monitoring that will be conducted semiannually in years 3 through 5 after completion of extraction, and annually thereafter until the groundwater COC concentrations are below the PCL or the regulators agree that less frequent sampling schedule is more appropriate

Areas around the wells will be cleared of vegetation and biohazards prior to each sampling event to protect the field staff. Low-flow groundwater sampling will be performed in accordance with Section 3.5 of the IWWP. Validated data packages will be provided at the monthly managers meeting as they become available.

8.3.1 Baseline Sampling

Monitoring wells 17WW01, 17WW02, 17WW03, 17WW06, and 130 will be analyzed for perchlorate prior to initiating extraction to allow establishment of baseline conditions against which the remedial performance can be evaluated. All network wells will be gauged for groundwater elevation.

8.3.2 Evaluation of Extraction Effectiveness

Groundwater samples from monitoring wells 17WW01, 17WW02, 17WW03, 17WW06, and 130 will be collected monthly for the first 6 months during operation to track the progress of perchlorate reduction. Sampling will be conducted quarterly for the next 12 months. All of the network wells will be gauged for groundwater elevation quarterly to evaluate the capture radius of the extraction system. Extraction will cease upon completion of the 18-month extraction period.

8.3.3 RA-O Monitoring Year 1 and Year 2

A network of wells will be selected to be sampled quarterly following the initial baseline sampling performed following the completion of the extraction period. **Table 8-2** contains an example of the network wells that may be selected and the monitoring planned for each location to monitor the performance of MNA and the long-term stability of the plume. The network shown on **Table 8-2** may change based on the conditions found after the completion of the extraction period. The process of biodegradation results in depletion of dissolved oxygen and oxidation-reduction potential. MNA monitoring will be conducted to evaluate change in geochemical conditions and COC concentrations and to verify that the plume extent is stable or shrinking. For the first two years post-extraction, the wells will be sampled quarterly, with results provided in the monthly managers meetings and summarized more fully in Annual RA-O reports described in **Section 8.5**.

8.3.4 RA-O Monitoring Years 3 through 5

After two years of quarterly performance monitoring and a successful demonstration that MNA is taking place, the monitoring will shift to semiannual RA-O monitoring, and the number of RA-O wells may be reduced based on the MNA monitoring results and recommendations made in RA-O Reports.

8.3.5 RA-O Monitoring Beyond Year 5

RA-O will continue annually after Year 5, if needed, using a monitoring network and analyte list established in the Year 5 RA-O Report based on the ongoing monitoring data. Monitoring will be discontinued with regulator concurrence after COC concentrations in all wells drop below the cleanup level. The need for any additional LTM will be discussed in the next Five Year Review.

8.4 Response Action Completion Report

A RACR will be submitted upon implementation of the groundwater extraction and completion of the excavation to document activities performed to complete the RA. Groundwater monitoring results collected during the extraction system operation will be provided during monthly managers meetings and quarterly memos will document the potentiometric surface data, radius of influence evaluation, extraction rates and perchlorate concentrations, and evaluate trends as appropriate.

8.5 Annual RA-O Reports

An Annual RA-O Report will be prepared at the end of each year to present groundwater monitoring results. During groundwater extraction, the report will summarize the performance of the pumping system and the analytical data collected from the extraction wells. Once monitoring for the MNA remedy begins, wells within the plume areas will be evaluated for effectiveness of MNA, and wells surrounding the plume will be used to evaluate plume stability. The report will provide recommendations, if possible, for reducing the number of monitoring wells to be included in the monitoring program and/or frequency of monitoring events.

8.5.1 MNA Evaluation

A technical evaluation of natural attenuation potential will be performed at the end of the first year and second year of groundwater monitoring. The USEPA guidance, Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater (USEPA 1998), will be used as guidance for the natural attenuation evaluation. The USEPA guidance specifies a tiered approach of recommended lines of evidence (LOE) required for demonstrating that MNA is an effective remedy.

There are three LOE according to the USEPA guidance document based on the Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-17 (USEPA 1999), which are described as follows:

- **First Line of Evidence.** Observed reduction in contaminant mass and concentration. Relies on use of historical groundwater data that demonstrate a clear trend of stable decreasing concentrations over time at appropriate monitoring or sampling points.
- **Second Line of Evidence.** Identified and Quantified Natural Attenuation Processes. Uses geochemical indicators to document certain geochemical signatures or "footprints" in the groundwater that demonstrate (indirectly) the type of natural attenuation process(es) occurring at the site and the rate at which such processes will reduce COCs to the cleanup levels (**Table 1-2**) or groundwater medium-specific concentration for industrial use (GW-Ind) levels established by TCEQ.
- **Third Line of Evidence.** Microcosm Studies. Most often consists of predictive modeling studies and other laboratory/field studies that demonstrate the occurrence of natural attenuation process(es) at the site and its ability to degrade the COC.

9.0 SCHEDULE

Table 9-1 shows the estimated duration for each major site activity and timeline. Weather and unknown site conditions could affect this schedule.

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10.0 OPERATION AND MAINTENANCE PROCEDURES

Some components of the final remedy at LHAAP-17 require O&M and those O&M activities are described in this section, along with other routine maintenance activities. The remedy components that require O&M are maintenance of the groundwater extraction system, maintenance of the MNA monitoring system (this would include all wells that serve some purpose) and maintenance of the LUCs. Extraction system O&M will be weekly (**Appendix D**), and the remaining activities will be conducted annually unless recommended otherwise during a Five Year Review.

10.1 Operation and Maintenance of the Groundwater Extraction System

The groundwater extraction system has been designed to require little in the way of direct operation and maintenance. The air compressor installed will be an oil-free design to minimize maintenance and the risk of oil entering the system. The pneumatically driven pumps do not require direct observation or control other than routine checks of their operation and volume extracted. The flow system high/low valves and transfer pump operation will be verified weekly, and flow volumes will be recorded weekly as well. A Weekly Extraction System Tracking and Maintenance Form will be used to record the inspections. The form is included in **Appendix D**.

10.2 Maintenance of the MNA Monitoring System

The MNA monitoring system is comprised of a network of monitoring wells used to implement/measure the progress of the MNA remedy. This system of wells will be inspected and maintained as part of the annual inspection and maintenance program. The monitoring wells will be inspected for the integrity of the pad, bollards, surface casing, and well markings, the presence and accumulation of silt in the well screen, the presence and integrity of a locking mechanism, the presence of encroaching vegetation, such as tree roots and weeds, and the presence of biological hazards, such as ant mounds and bee nests. Maintenance activities will be performed as needed and could include replacement of the pads and well markings, resurfacing/painting the well casing and bollards, and redevelopment of the wells. Photo documentation of well conditions will be collected during inspection and maintenance activities. The annual inspection and maintenance activities will be documented in the Annual RA-O reports.

10.3 LUC Maintenance and Monitoring Requirements

The LUCs will be maintained in place as follows:

- The LUC restricting land use to non-residential will remain in place until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure;
- The LUC to maintain the integrity of any current or future remedial or monitoring systems will remain in place until groundwater cleanup levels of COCs are met; and
- The LUC prohibiting groundwater use as a potable source will remain in place until the levels of COCs in groundwater allow for unlimited use and unrestricted exposure.

The administrative maintenance required to ensure the three LUCs remain in place and effective until the cleanup levels of the COCs are at levels that allow unrestricted use and unlimited exposure is as follows:

- Annual field inspections of the site to confirm that no violations of the LUCs have occurred.
- Annual certifications that no LUC-restricted activities have been authorized and that site conditions and use are consistent with the LUCs. The Certification Form is presented in **Appendix E**).
- Periodic transmittal of a LUC Notice to federal, state, and local authorities and to owners and occupants of LHAAP-17. The notice will include the groundwater contamination and any land use restrictions referenced in the ROD, a written description of the LUCs, and a figure depicting the LUC boundaries. The transmittal will coincide with each Five Year Review and will be documented in the report.
- The final LUC RD appendix of the RACR will be added to the Comprehensive LUC Management Plan, and the plan will be provided to the owner or occupant of LHAAP-17.

The U.S. Army will address LUC problems within its control that are likely to impact remedy integrity and shall address problems as soon as practicable.

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Tables

Table 1-2
Cleanup Levels for Human Health Risk

Medium	Chemical of Concern	Cleanup Level
		MCL (µg/L)
Shallow Zone groundwater	1,1-Dichloroethene	7
	1,2-Dichloroethane	5
	cis-1,2-Dichloroethene	70
	Trichloroethene	5
	Vinyl Chloride	2
		Texas Risk Reduction Program $^{GW}GW_{Ing}$ PCL (µg/L)
	Perchlorate	17
		MCL (µg/L)
Intermediate Zone groundwater	cis-1,2-Dichloroethene	70
	Trichloroethene	5
	Vinyl Chloride	2
		GWP-Ind (mg/kg)
Soil	2,4,6-Trinitrotoluene	5.1
	2,4-Dinitrotoluene	0.042
	2,6-Dinitrotoluene	0.042
	Perchlorate	7.2

Notes:

µg/L - micrograms per liter

GWP-Ind - Texas Commission on Environmental Quality soil medium specific concentration for industrial use based on groundwater protection (30TAC335)

MCL - Safe Drinking Water Act maximum contaminant level

mg/kg - milligrams per kilogram

PCL - protective concentration level (Tier 1 Texas Risk Reduction Program $^{GW}GW_{ING}$)

Table 1-3
Cleanup Levels for Ecological Risk in Soil (EcoPRGs)

Chemical	SS EcoPRG [a] (mg/kg)	TS EcoPRG [a] (mg/kg)	Depth [b]
Barium	222	–	0 - 0.5 feet
	–	520	0 - 3 feet
2,4-Dinitrotoluene	–	12	0 - 3 feet
2,6-Dinitrotoluene	2.7	6.8	0 - 3 feet
2,4,6-Trinitrotoluene	–	4.7	0 - 3 feet
2,3,7,8-TCDD TEC	4×10^{-6}	4×10^{-6}	0 - 3 feet

Notes:

[a] From Baseline Ecological Risk Assessment Table 16-1 (Shaw 2007b).

[b] Depth and locations of remedial action for Waste Sub-Area.

EcoPRG - ecological preliminary remediation goal

mg/kg - milligrams per kilogram

SS - surface soil from 0 to 0.5 feet (applicable to deer mouse)

TCDD - tetrachlorodibenzo-p-dioxin

TEC - toxicity equivalence concentration

TS - total soil from 0 to 3 feet (applicable to short-tailed shrew)

Table 3-1
August 2018 Soil Sample Analytical Results

	Location Code		17SS67		17SS68		17SS69		17SS70	
	Sample ID		17SS67-0.0-0.5		17SS68-0.0-0.5		17SS69-0.0-0.5		17SS70-0.0-0.5	
	Sample Date		8/9/2018		8/9/2018		8/9/2018		8/9/2018	
	Depth									
Analyte	Units	Soil Cleanup Goal [a]	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Explosives										
2,4,6-Trinitrotoluene	mg/kg	1.83	NA		NA		NA		NA	
2,4-Dinitrotoluene	mg/kg	0.0125	NA		NA		NA		NA	
2,6-Dinitrotoluene	mg/kg	0.0125	NA		NA		NA		NA	
Metals										
Barium	mg/kg	222	280		4480		252		120	

Notes:

Blue highlighted concentrations in bold exceed the ecological SS PRG for Barium.

[a] - The Soil Cleanup Goal for explosives is the human health soil standard from the Final Record of Decision, and the Soil Cleanup Goal for Barium is the ecological surface soil preliminary remediation goal from the Final Record of Decision.

NA - Sample was not analyzed for the analye

U - Undetected: The analyte was analyzed for, but not detected.

mg/kg - milligrams per kilogram

Val Qual - validation qualifier

Table 3-1
August 2018 Soil Sample Analytical Results

	Location Code		17SS71				17SS72		17SS73	
	Sample ID		17SS71-0.0-2.0		17SS71-5.0-7.0		17SS72-0.0-2.0		17SS73-0.0-2.0	
	Sample Date		8/9/2018		8/9/2018		8/9/2018		8/9/2018	
	Depth									
Analyte	Units	Soil Cleanup Goal [a]	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Explosives										
2,4,6-Trinitrotoluene	mg/kg	1.83	< 0.0281	U	< 0.0288	U	< 0.029	U	< 0.0282	U
2,4-Dinitrotoluene	mg/kg	0.0125	< 0.0281	U	< 0.0288	U	< 0.029	U	< 0.0282	U
2,6-Dinitrotoluene	mg/kg	0.0125	< 0.0281	U	< 0.0288	U	< 0.029	U	< 0.0282	U
Metals										
Barium	mg/kg	222	NA		NA		NA		NA	

Notes:

Blue highlighted concentrations in bold exceed the ecological SS PRG for Barium.

[a] - The Soil Cleanup Goal for explosives is the human health soil standard from the Final Record of Decision, and the Soil Cleanup Goal for Barium is the ecological surface soil preliminary remediation goal from the Final Record of Decision.

NA - Sample was not analyzed for the analye

U - Undetected: The analyte was analyzed for, but not detected.

mg/kg - milligrams per kilogram

Val Qual - validation qualifier

Table 3-1
August 2018 Soil Sample Analytical Results

	Location Code		17SS74				17SS75			
	Sample ID		17SS74-0.0-2.0		17SS74-5.0-7.0		17SS75-0.0-0.5		17SS75-0.0-0.5-FD	
	Sample Date		8/9/2018		8/9/2018		8/8/2018		8/8/2018	
	Depth									
Analyte	Units	Soil Cleanup Goal [a]	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Explosives										
2,4,6-Trinitrotoluene	mg/kg	1.83	< 0.0268	U	< 0.0315	U	NA		NA	
2,4-Dinitrotoluene	mg/kg	0.0125	< 0.0268	U	< 0.0315	U	NA		NA	
2,6-Dinitrotoluene	mg/kg	0.0125	< 0.0268	U	< 0.0315	U	NA		NA	
Metals										
Barium	mg/kg	222	NA		NA		78.9		71.3	

Notes:

Blue highlighted concentrations in bold exceed the ecological SS PRG for Barium.

[a] - The Soil Cleanup Goal for explosives is the human health soil standard from the Final Record of Decision, and the Soil Cleanup Goal for Barium is the ecological surface soil preliminary remediation goal from the Final Record of Decision.

NA - Sample was not analyzed for the analye

U - Undetected: The analyte was analyzed for, but not detected.

mg/kg - milligrams per kilogram

Val Qual - validation qualifier

Table 3-1
August 2018 Soil Sample Analytical Results

	Location Code		17SS76		17SS77		17SS78	
	Sample ID		17SS76-0.0-0.5		17SS77-0.0-0.5		17SS78-0.0-0.5	
	Sample Date		8/8/2018		8/8/2018		8/8/2018	
	Depth							
Analyte	Units	Soil Cleanup Goal [a]	Result	Val Qual	Result	Val Qual	Result	Val Qual
Explosives								
2,4,6-Trinitrotoluene	mg/kg	1.83	NA		NA		NA	
2,4-Dinitrotoluene	mg/kg	0.0125	NA		NA		NA	
2,6-Dinitrotoluene	mg/kg	0.0125	NA		NA		NA	
Metals								
Barium	mg/kg	222	88.1		90.5		72.8	

Notes:

Blue highlighted concentrations in bold exceed the ecological SS PRG for Barium.

[a] - The Soil Cleanup Goal for explosives is the human health soil standard from the Final Record of Decision, and the Soil Cleanup Goal for Barium is the ecological surface soil preliminary remediation goal from the Final Record of Decision.

NA - Sample was not analyzed for the analye

U - Undetected: The analyte was analyzed for, but not detected.

mg/kg - milligrams per kilogram

Val Qual - validation qualifier

Table 4-1
Proposed Excavation Sampling Summary

Excavation Area	Excavation Depth (Feet)	Estimated Total Volume (CY)	Estimated Floor Area (Square Feet)	Existing Sidewall Samples	Existing Floor Samples	Estimated Additional Samples Required [a]
A	2	81	1,094	17SS48, 17SS49, 17SS51	No Floor Samples - 2' Ecological Excavation	1 sidewall (east)
B	2	32	431	17SS75, 17SS76, 17SS77, and 17SS78	No Floor Samples - 2' Ecological Excavation	None
C	2	122	1,641	17SS70	No Floor Samples - 2' Ecological Excavation	3 sidewall samples (east, west, north)
D	7	390	1,504	17SS71 and 17SS74	None	2 sidewall (east and west) and 2 floor
E	2	43	590	17SS52 and 17SS53	No Floor Samples - 2' Ecological Excavation	2 sidewall (east and south)
F	2	31	419	17SS79, 17SS80, 17SS81, and 17SS82	No Floor Samples - 2' Ecological Excavation	None
G	2.5	92	995	17SS99, 17SS100, 17SS101, and 17SS102	COE17-14A (2.5')	None
H	2.5 - 7	2,342	17,217	17SS24 and 17SS89	17SS21A (7'), 17SS22A (3'), 17SS25A (7'), 17SS88 (2.5')	5 sidewall (2 north, east, west, south, and 14 floor)
J	5.5 - 7.5	563	2,586	17SS90	17SB03 (7.5'), 17SS29A (5.5'), and 17SS91 (5.5')	3 wall (north, south, and west)
K	2.5	482	5,204	17SS28 and 17SS109 (17SS83 just beyond northern boundary)	17SS27A (2.5'), 17SS84 (2.5'), 17SS85 (2.5'), 17SS86 (2.5'), 17SS87 (2.5'), and 17WW01A (2.5')	2 wall (south and east)
L	2.5 - 5	537	4,782	17SS97 and 17SS98	17SB04A (5'), 17SS92 (5'), 17SS93 (2.5'), 17SS94 (2.5'), and COE17-08A (2.5')	3 wall (north, west and southwest)
M	2.5 - 7.5	308	2,552	17SS104	17SS103 (2.5'), 17SS105 (2.5'), and 17SB06A (7.5')	4 sidewall (north, west, south, and composite of deeper bench)
N	2.5 - 4	279	2,634	17SS104	COE17-16A (4') and 17SS108 (2.5')	3 sidewall (north, east, and south) and 1 floor
	Estimated Total Volume (CY)	5,302			Total # Samples to be Collected	28 sidewall and 17 floor

Notes:

[a] Based on the depths of the excavation walls, 1,000 square feet of wall represents a longer wall than any single excavation wall anticipated based on Figure 4-1. Therefore, the number of wall samples required was estimated by subtracting the number of existing wall samples from the number of excavation walls.

Table 5-1
Groundwater Analytical Data (2009 to 2018)

Sample Location	Aquifer Zone	Date	Trichloroethene (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	Perchlorate (µg/L)
120	Shallow	12/14/2017	27,000	250	110	65,000
130	Shallow	3/4/2009	31.1	ND	4.29	1,700
		11/14/2017	2.1	ND	ND	2.5
17WW01	Shallow	3/4/2009	6,090	70	35.8	56,000
		9/10/2010	7,160	84.5	45.9	28,000
		11/14/2017	6,100	240	87	< 4
17WW02	Shallow	3/5/2009	867	6.22	34.5	160,000
		9/10/2010	326	3.82	39.3	122,000
		11/15/2017	6.2	< 1	3.3	2,500
17WW03	Shallow	3/5/2009	12.8	< 0.5	0.26 J	< 0.44
		9/10/2010	15.1	< 0.5	0.381 J	2.71
		11/14/2017	5.3	< 1	< 1	< 4
17WW04	Shallow	3/2/2009	0.914 J	< 0.5	< 0.25	< 0.22
		9/10/2010	1.85	1.1	0.282 J	< 0.1
		11/16/2017	< 1	< 1	< 1	< 4
17WW06	Shallow	3/5/2009	176	8.5	5.68	74,000
		9/10/2010	225	7	6.9	86,100
		11/16/2017	260	7.6	8.4	110,000
17WW08	Shallow	2/25/2009	< 0.25	< 0.5	< 0.25	< 0.22
		9/10/2010	< 0.25	NA	< 0.25	< 0.1
		12/16/2013	< 0.5	NA	< 0.5	< 0.159
		12/1/2015	< 0.5	NA	< 0.5	NA
		6/10/2016	< 0.5	< 1	< 0.5	7.13
		12/6/2016	< 0.5	NA	< 0.5	< 0.2
		6/20/2017	< 0.5	< 1	< 0.5	< 0.2
		11/14/2017	< 1	< 1	< 1	< 4
17WW09	Intermediate	2/26/2009	< 0.25	< 0.5	< 0.25	< 0.11
		9/11/2010	< 0.25	< 0.5	< 0.25	< 0.1
		11/15/2017	< 1	< 1	< 1	< 4
17WW10	Shallow	2/26/2009	< 0.25	< 0.5	< 0.25	< 0.55
		9/10/2010	< 0.25	< 0.5	< 0.25	< 0.1
		11/15/2017	< 1	< 1	< 1	1.6 J
17WW11	Shallow/ Intermediate	2/26/2009	< 0.25	< 0.5	< 0.25	< 0.22
		11/14/2017	< 1	< 1	< 1	< 4
17WW12	Shallow	2/26/2009	< 0.25	< 0.5	< 0.25	290
		3/30/2009	NA	NA	NA	990
		9/11/2010	< 0.25	< 0.5	< 0.25	62.9
		2/15/2018	< 0.5	< 0.5	< 0.5	< 4
17WW13	Shallow	3/3/2009	< 0.25	< 0.5	< 0.25	< 0.55
		9/11/2010	< 0.25	< 0.5	< 0.25	< 0.1
		11/14/2017	1.5	< 1	1.5	< 4
17WW14	Shallow	2/25/2009	< 0.25	< 0.5	< 0.25	< 0.55
		9/11/2010	< 0.25	< 0.5	< 0.25	0.196 J
		11/14/2017	< 1	< 1	< 1	2.5 J
17WW17	Intermediate	3/4/2009	10.8	1.92	0.274 J	< 0.22
		9/11/2010	6.34	0.936 J	< 0.25	< 0.1
		11/15/2017	< 1	< 1	< 1	< 4
17WW18	Intermediate	3/3/2009	< 0.25	< 0.5	< 0.25	< 0.44
		9/11/2010	< 0.25	< 0.5	< 0.25	0.708
		11/15/2017	< 1	< 1	< 1	0.595
17WW19	Shallow	1/15/2018	< 1	< 1	< 1	< 4
17WW20	Shallow	5/8/2018	1.6	< 0.5	< 0.5	< 2
18CPTMW22R	Shallow	6/9/2016	< 0.5	NA	NA	0.917
		12/14/2017	< 1	NA	NA	8.3
18WW10	Shallow	4/1/2009	< 0.25	NA	NA	< 0.11
		9/25/2009	< 0.25	NA	NA	< 0.6
		3/11/2010	< 0.25	NA	NA	< 1.2
		9/8/2010	< 0.25	NA	NA	< 1.2
		3/16/2011	< 0.25	NA	NA	< 0.1
		9/14/2011	< 0.25	NA	NA	< 0.1
		3/9/2012	< 0.25	NA	NA	< 0.1
		9/24/2012	< 0.25	NA	NA	< 0.2
		11/15/2017	< 1	< 1	< 1	52
18WW14	Shallow	3/3/2009	< 0.25	NA	NA	< 0.22
		12/2/2015	< 0.5	NA	NA	NA
		11/16/2017	< 1	< 1	< 1	< 4
C-07	Shallow	11/16/2017	< 1	< 1	< 1	4.4

Table 5-1
Groundwater Analytical Data (2009 to 2018)

Sample Location	Aquifer Zone	Date	Trichloroethene (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	Perchlorate (µg/L)
MW-7	Shallow	9/20/2011	4,220	NA	NA	49,600
		3/7/2012	4,640	NA	NA	49,300
		9/26/2012	2,130	NA	NA	34,100
		5/14/2013	2,690	NA	NA	37,500
		12/14/2013	2,140	NA	NA	36,700
		8/22/2014	1,680	NA	NA	31,100
		12/17/2014	1,880	NA	NA	32,100
		6/17/2015	1,860	NA	NA	26,800
		12/1/2015	2,730	NA	NA	20,700
		6/24/2016	1,740	NA	NA	22,200
		12/6/2016	1,570	NA	NA	12,300
		6/23/2017	2,230	NA	NA	22,200
		12/13/2017	1,600	< 1	17	15,000
MW-8	Shallow	4/3/2009	1,790	NA	NA	35,000
		9/21/2009	2,200	NA	NA	38,000
		3/9/2010	1,740	NA	NA	34,000
		9/8/2010	1,840	NA	NA	54,000
		3/17/2011	1,140	NA	NA	53,200
		9/15/2011	1,120	NA	NA	64,500
		3/8/2012	1,360	NA	NA	78,000
		9/27/2012	959	NA	NA	72,500
		5/16/2013	907	NA	NA	72,000
		12/19/2013	1,430	NA	NA	63,600
		12/10/2014	1,180	NA	NA	53,200
		6/15/2015	575	NA	NA	40,700
		12/7/2015	487	NA	NA	NA
		6/9/2016	247	NA	NA	8,290
		12/15/2016	245	NA	NA	2,160
		6/16/2017	296	NA	NA	5,320
		12/12/2017	270	< 1	4	5,500
MW-9	Shallow	9/14/2011	5,900	NA	NA	1,780
		3/7/2012	2,240	NA	NA	963
		9/27/2012	5,620	NA	NA	1,340
		5/9/2013	2,400	NA	NA	320
		12/13/2013	1,810	NA	NA	132
		8/21/2014	2,910	NA	NA	1,530
		12/16/2014	3,030	NA	NA	790
		12/1/2015	2,430	NA	NA	NA
		6/22/2016	1,460	NA	NA	263
		12/6/2016	1,250	NA	NA	219
		6/23/2017	661	NA	NA	86.9
		12/11/2017	930	< 1	0.82 J	44
MW-10	Shallow	9/28/2012	0.568 J	NA	NA	< 0.2
		5/8/2013	0.698 J	NA	NA	< 0.2
		12/11/2013	0.554 J	NA	NA	2.74
		6/3/2014	1.01	NA	NA	156
		12/10/2014	0.561 J	NA	NA	< 0.2
		6/11/2015	35.3	NA	NA	3.69
		12/15/2015	4.17	NA	NA	1.26 J
		6/9/2016	0.796 J	NA	NA	0.492
		12/7/2016	0.745 J	NA	NA	< 0.2
		3/20/2017	0.447 J	NA	NA	< 0.2
		6/20/2017	0.701 J	NA	NA	< 0.2
		12/13/2017	< 1	< 1	< 1	< 0.2
MW-16	Shallow	12/8/2017	300	3.6	23	< 0.2
MW-17	Shallow	3/24/2011	0.551 J	NA	NA	0.179 J
		9/15/2011	1.14	NA	NA	< 0.1
		3/9/2012	0.537 J	NA	NA	< 0.1
		9/24/2012	0.943 J	NA	NA	< 0.2
		5/10/2013	0.519 J	NA	NA	< 0.2
		12/16/2013	0.656 J	NA	NA	0.376 J
		6/4/2014	1.69	NA	NA	< 0.2
		12/10/2014	NA	NA	NA	0.143 J
		12/14/2015	NA	NA	NA	24.4 J
		6/20/2016	< 0.5	NA	NA	< 0.2
		12/7/2016	< 0.5	NA	NA	< 0.2
		6/21/2017	< 0.5	NA	NA	< 0.2
		12/11/2017	NA	NA	NA	< 0.2

Table 5-1
Groundwater Analytical Data (2009 to 2018)

Sample Location	Aquifer Zone	Date	Trichloroethene (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	Perchlorate (µg/L)
MW-18	Shallow	3/3/2009	0.677 J	NA	NA	< 0.11
		7/14/2009	NA	NA	NA	< 4
		9/28/2012	0.5	NA	NA	0.246 J
		5/8/2013	2.57	NA	NA	0.783
		12/18/2013	1.95	NA	NA	< 0.2
		6/13/2014	7.23	NA	NA	0.154 J
		12/23/2014	2.71	NA	NA	< 0.2
		6/22/2015	130	NA	NA	< 2
		12/7/2015	35.9	NA	NA	10.3
		6/17/2016	14.1	NA	NA	< 0.2
		12/15/2016	7.58	NA	NA	< 0.2
		6/21/2017	5.7	NA	NA	< 0.2
		12/11/2017	4.8	< 1	< 1	< 0.2
MW-19	Shallow	7/14/2009	NA	NA	NA	< 3
		9/27/2012	6.07	NA	NA	< 0.2
		5/8/2013	16	NA	NA	< 0.2
		12/17/2013	6.38	NA	NA	< 0.2
		6/13/2014	12.1	NA	NA	0.548
		12/23/2014	31.4	NA	NA	0.229 J
		6/22/2015	31.1	NA	NA	< 2
		12/5/2015	24.6	NA	NA	NA
		6/17/2016	1.82	NA	NA	11.4
		12/21/2016	2.62	NA	NA	< 0.2
		3/22/2017	3.71	NA	NA	< 0.2
		6/20/2017	9.87	NA	NA	< 0.2
		12/12/2017	3.2	< 1	< 1	< 0.2
MW-20	Shallow	4/1/2009	< 0.25	NA	NA	< 0.22
		9/21/2009	< 0.25	NA	NA	< 0.3
		3/8/2010	< 0.25	NA	NA	0.65 J
		9/9/2010	< 0.25	NA	NA	< 0.3
		3/15/2011	0.355 J	NA	NA	< 0.1
		9/13/2011	< 0.25	NA	NA	0.216
		3/7/2012	0.441 J	NA	NA	0.148 J
		6/9/2015	< 0.5	NA	NA	4
		12/6/2016	< 0.5	NA	NA	< 0.2
		12/14/2017	< 1	< 1	< 1	1.9J
MCL / PCL			5	7	5	17

Notes:
µg/L - micrograms per liter
MCL - Safe Drinking Water Act maximum contaminant level (used for trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethane)
PCL - Texas Risk Reduction Program $^{GW}GW_{ING}$ protective concentration level (used for perchlorate)
Concentrations shown in boldface type exceed the MCL/PCL
NA - not analyzed
J - concentration shown is estimated

Table 5-2
Estimated Pore Volume and Extraction Volume Calculations

Pore Volume Calculation	
Average Saturated Thickness (feet)	12
Plume Area Based on Figure 5-3 17 µg/L contour (feet^2)	58,000
Estimated Porosity (fine sand) (%)	0.35
Estimated Total Pore Volume (Area x Thickness x porosity) (feet^3)	243,600
Estimated Total Pore Volume (Volume in feet^3 x 7.48) (gallons)	1,822,128

Estimated Extraction Volume Calculation	
17WW02 Projected Pumping Rate (gallons per minute)	0.4
17WW06 Projected Pumping Rate (gallons per minute)	2.5
Minutes/Day	1,440
Total number of Pumping Days (18 months - 10 days down time)	539
17WW02 Projected Total Extraction Volume (rate x mins/day x days) (gallons)	310,464
17WW06 Projected Total Extraction Volume (rate x mins/day x days) (gallons)	1,940,400
Total Projected Volume Extracted (gallons)	2,250,864
Estimated Pore Volumes Removed by 17WW02 and 17WW06 in 18 Months of Extraction	1.24
17WW01 Projected Pumping Rate (gallons per minute)	1.5
Minutes/Day	1,440
Total number of Pumping Days (18 months - 10 days down time)	539
17WW01 Projected Total Extraction Volume (rate x mins/day x days) (gallons)	1,164,240
Estimated Pore Volumes Removed by 17WW01, 17WW02, and 17WW06 in 18 Months of Extraction	1.87

Table 8-1
Proposed MNA Monitoring Network Locations

Location ID	Aquifer Zone	Northing	Easting	Ground Surface Elevation	Top of Casing Elevation
130	Shallow	6952823.84	3315814.59	174.94	177.73
17WW01	Shallow	6952637.54	3315690.63	176.62	179.01
17WW02	Shallow	6952784.79	3315651.12	174.34	177.21
17WW03	Shallow	6952651.91	3315789.22	176.39	179.2
17WW04	Shallow	6952536.34	3315473.48	177.29	180.21
17WW06	Shallow	6952718.3	3315475.11	176.82	179.36
17WW08	Shallow	6952492.98	3315991.09	176.76	179.94
17WW09	Intermediate	6952843.2	3315374.47	178.4	181.43
17WW10	Shallow	6952842.29	3315390.11	178.38	181.55
17WW11	Shallow/ Intermediate	6952970.73	3315572.84	177.51	180.95
17WW13	Shallow	6952679.23	3315986.44	175.9	179.14
17WW14	Shallow	6952609.79	3315323.86	178.83	181.9
17WW17	Intermediate	6952646.74	3315700.8	176.23	178.81
17WW18	Intermediate	6952976.4	3315886.53	176.03	178.68
17WW19	Shallow	6952718.36	3315313.67	180.08	176.63
17WW20	Shallow	6952980.24	3315580.24	180.02	177.13
MW-18	Shallow	6953262.29	3315771.7	177.27	178.58

Table 8-2

Proposed MNA Monitoring Network Analytes and Frequency

Monitoring Locations	Well Description	Years 1 & 2 (Quarterly)						Year 3-5 (Semiannual)					
		Perchlorate (314.0)	VOCs [a] (SW8260B)	Field Parameters [b]	TOC (EPA 415.1/ SW9060A/SM 5310C)	Anions [c] (SW9056A)	Methane/Ethane/ Ethene/CO2 (RSK-175)	Perchlorate (314.0)	VOCs [a] (SW8260B)	Field Parameters [b]	TOC (EPA 415.1/ SW9060A/SM 5310C)	Anions [c] (SW9056A)	Methane/Ethane/ Ethene/CO2 (RSK-175)
17WW01	Shallow well, COC > Cleanup level	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17WW02	Extraction well, COC > Cleanup level	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17WW03	Shallow well, COC > Cleanup level	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17WW04	Shallow well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
17WW06	Extraction well, COC > Cleanup level	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17WW08	Shallow well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
17WW10	Shallow well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
17WW11	Shallow/intermediate well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
17WW13	Shallow well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
17WW14	Shallow well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
17WW19	Shallow well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
17WW20	Shallow well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
130	Shallow well, all COC < Cleanup level	✓	✓	✓				✓	✓	✓			
17WW09	Intermediate well, all COC < cleanup level	✓	✓	✓				✓	✓	✓			
17WW17	Intermediate well, all COC < cleanup level	✓	✓	✓				✓	✓	✓			
17WW18	Intermediate well, all COC < cleanup level	✓	✓	✓				✓	✓	✓			

Notes:

[a] Volatile organic compounds (VOCs) include 1,1-dichloroethene (DCE), 1,2-dichloroethane, cis-1,2-DCE, trichloroethene (TCE), vinyl chloride.

[b] Field parameters for all wells include pH, temperature, conductivity, turbidity, oxidation-reductions potential (ORP), dissolved oxygen (DO), and ferrous iron.

[c] Anions include nitrate, sulfate, and chloride.

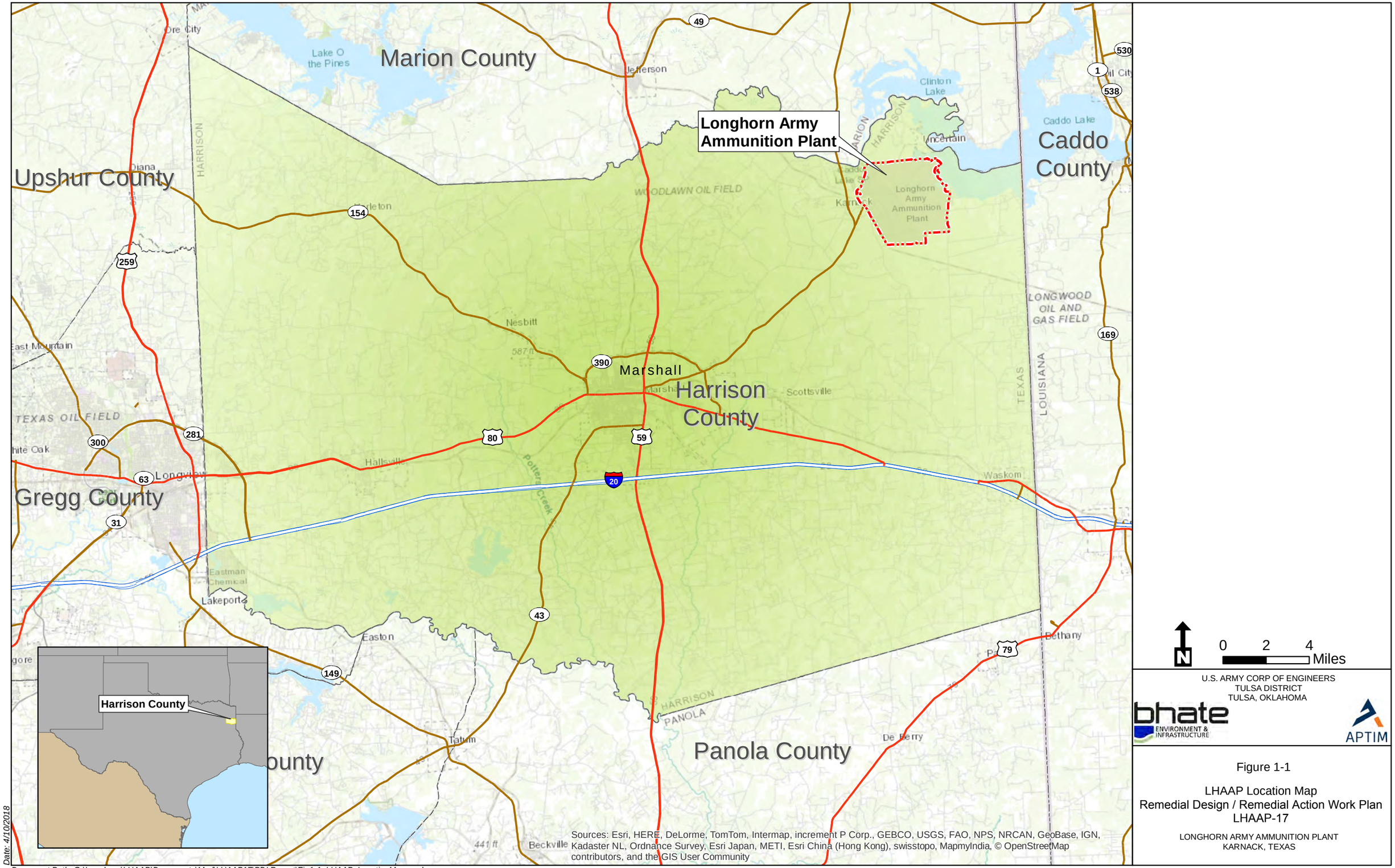
✓ Indicates that sample will be collected and analyzed for the listed analyte.

TOC Total Organic Carbon

Table 9-1
Schedule for Major Site Activities

Activities	Duration
Site Preparation and Mobilization	15
Baseline Sampling and Gauging	3
Utility Clearance	1
Excavation	15
Characterization and Confirmation Sampling	10
Loading Stockpiled Soil, T&D, Over-excavation, Confirmation Sampling	40
Site Backfill and Restoration	10
Groundwater Extraction System Construction	15
Surveying	5
Demobilization	3
Total No. of days	117

Figures



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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Figure 1-1

LHAAP Location Map
Remedial Design / Remedial Action Work Plan
LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 4/10/2018

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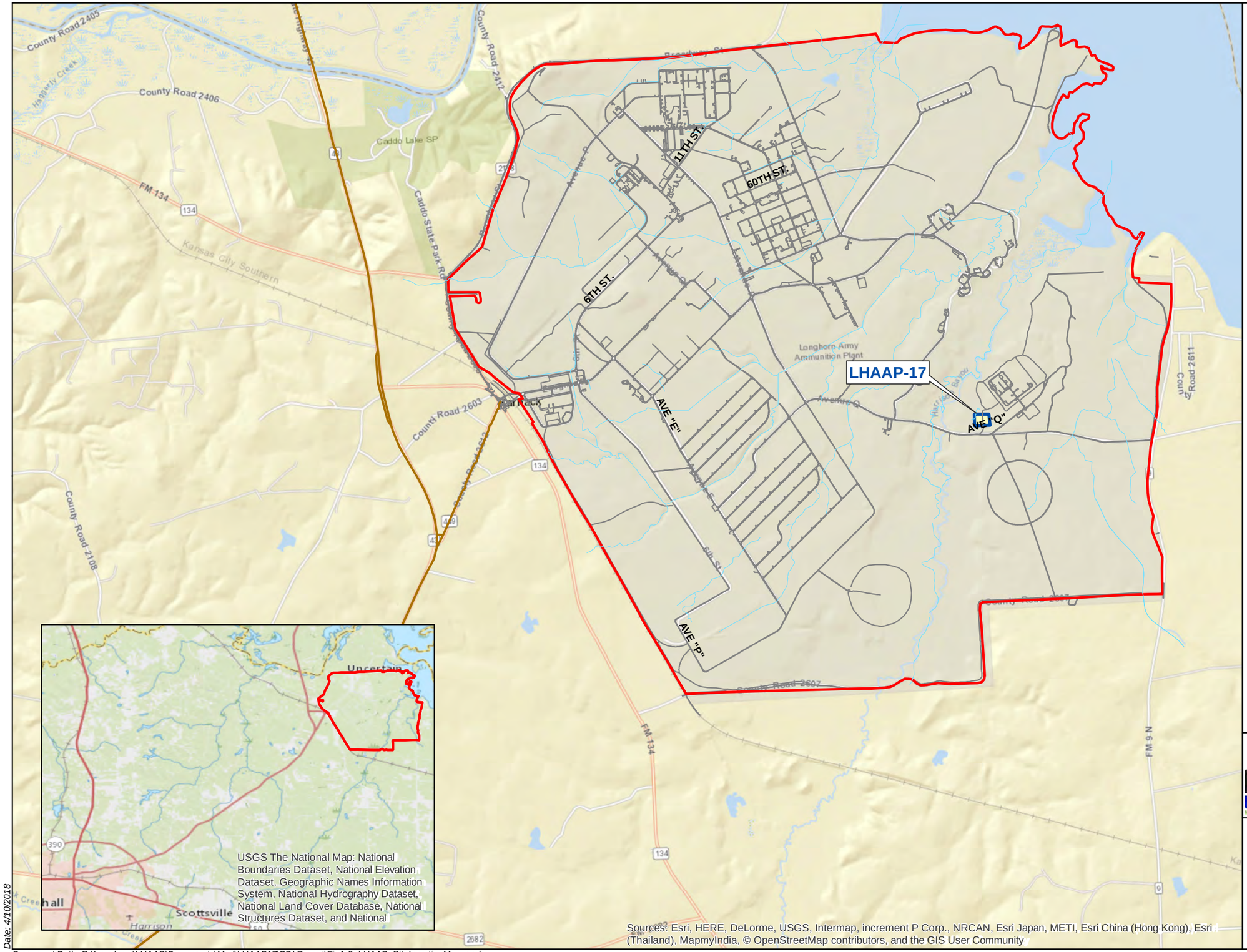

Stream
Road
LHAAP Boundary
LHAAP-17 Site Boundary

N

0 1,500 3,000
Feet

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Figure 1-2

LHAAP-17 Location Map

Remedial Design / Remedial Action Work Plan

LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 4/10/2018

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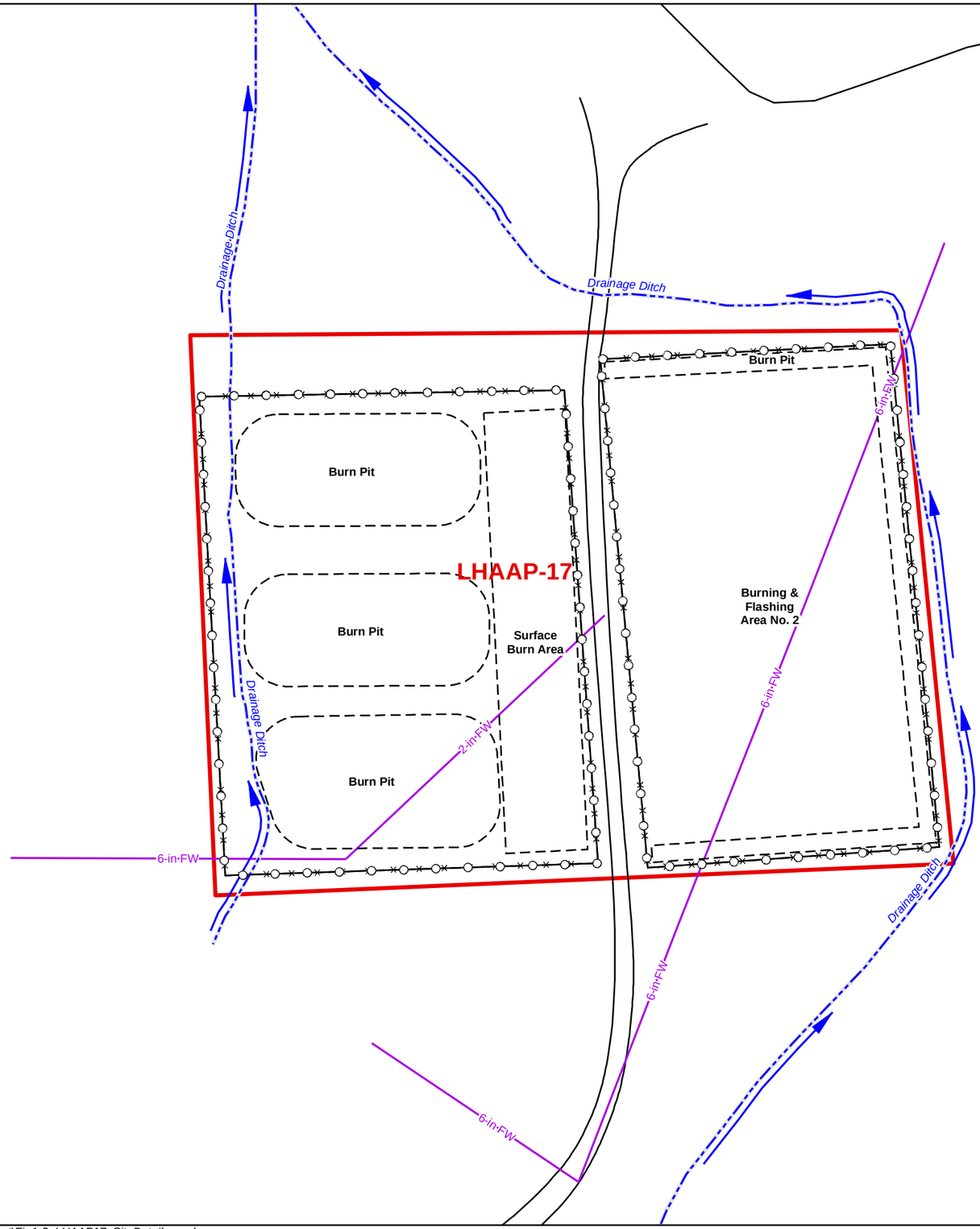

Fence Line

Surface Water Flow Direction

Drainage Ditch

2 inch (in) and 6 inch Diameter
Fire Water (FW) Line (Respectively)

Site Boundary

N

0 40 80 Feet

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Figure 1-3

LHAAP-17 Site Details

Remedial Design / Remedial Action Work Plan
LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 4/10/2018

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\PDI Report\Fig1-3_LHAAP17_SiteDetails.mxd

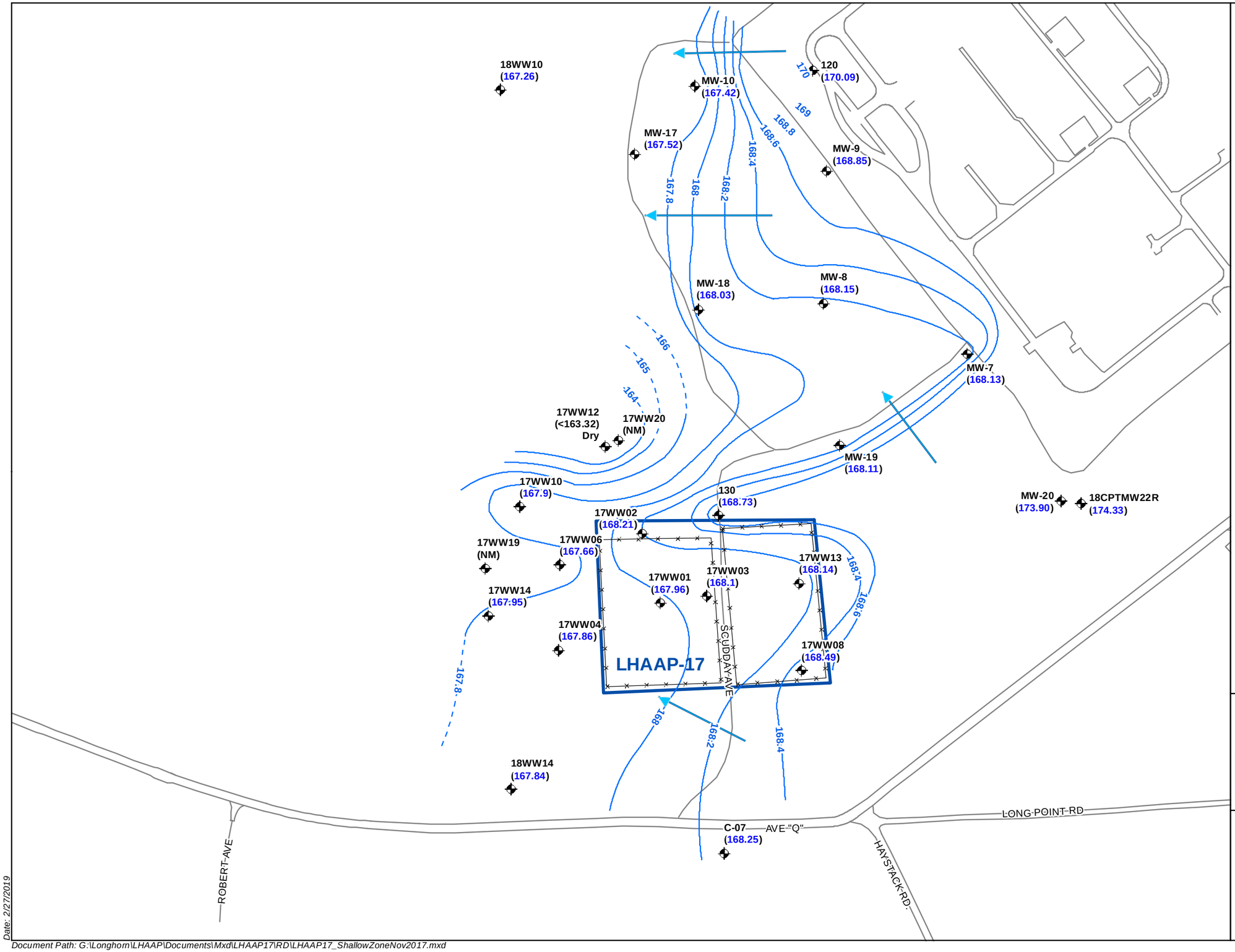

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Figure 2-1

Shallow Zone Potentiometric Surface
(November 2017)
Remedial Design/Remedial Action Work Plan, LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_ShallowZoneNov2017.mxd

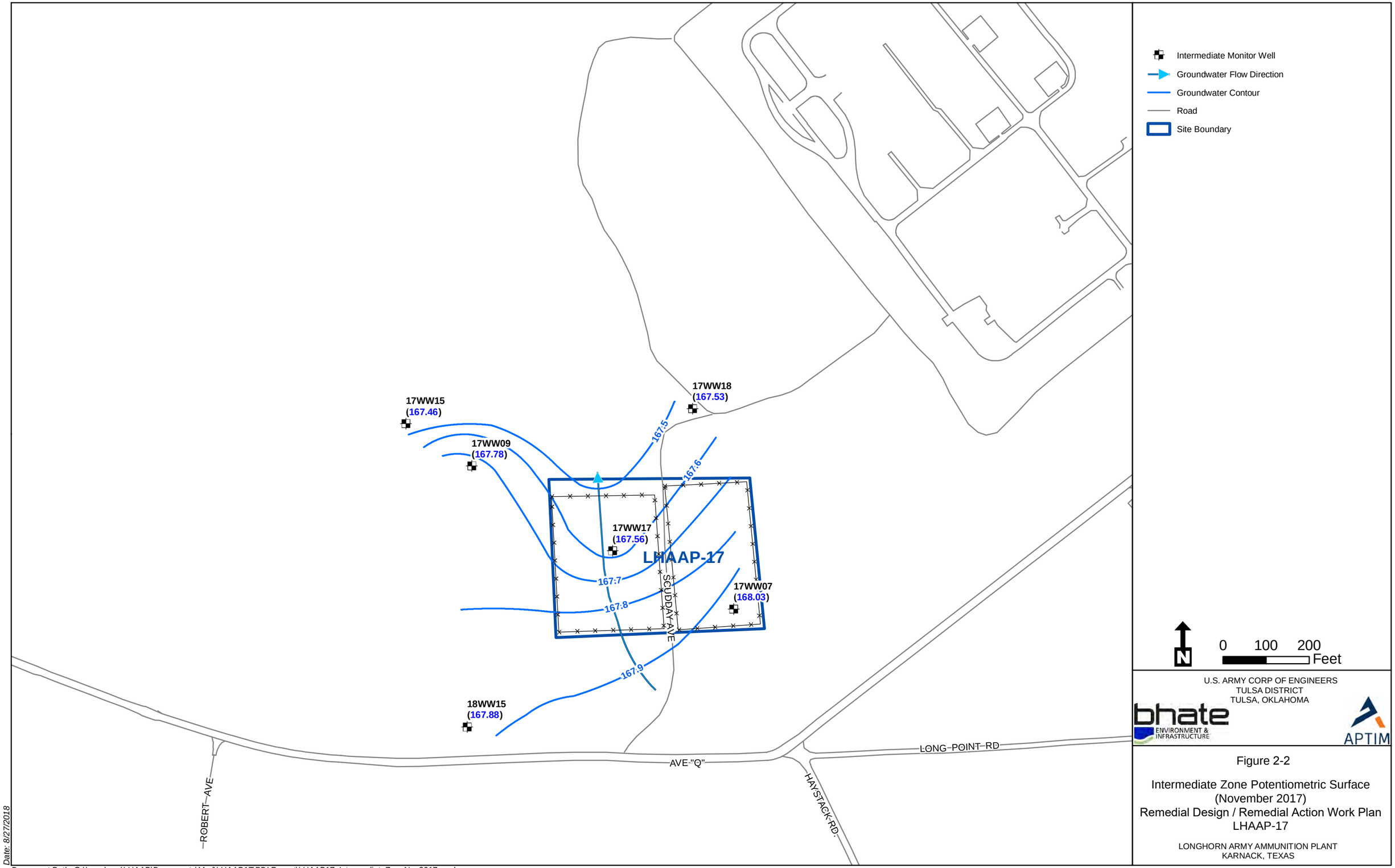

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Figure 2-2

Intermediate Zone Potentiometric Surface
(November 2017)
Remedial Design / Remedial Action Work Plan
LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 8/27/2018

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\PDI Report\LHAAP17_IntermediateZoneNov2017.mxd

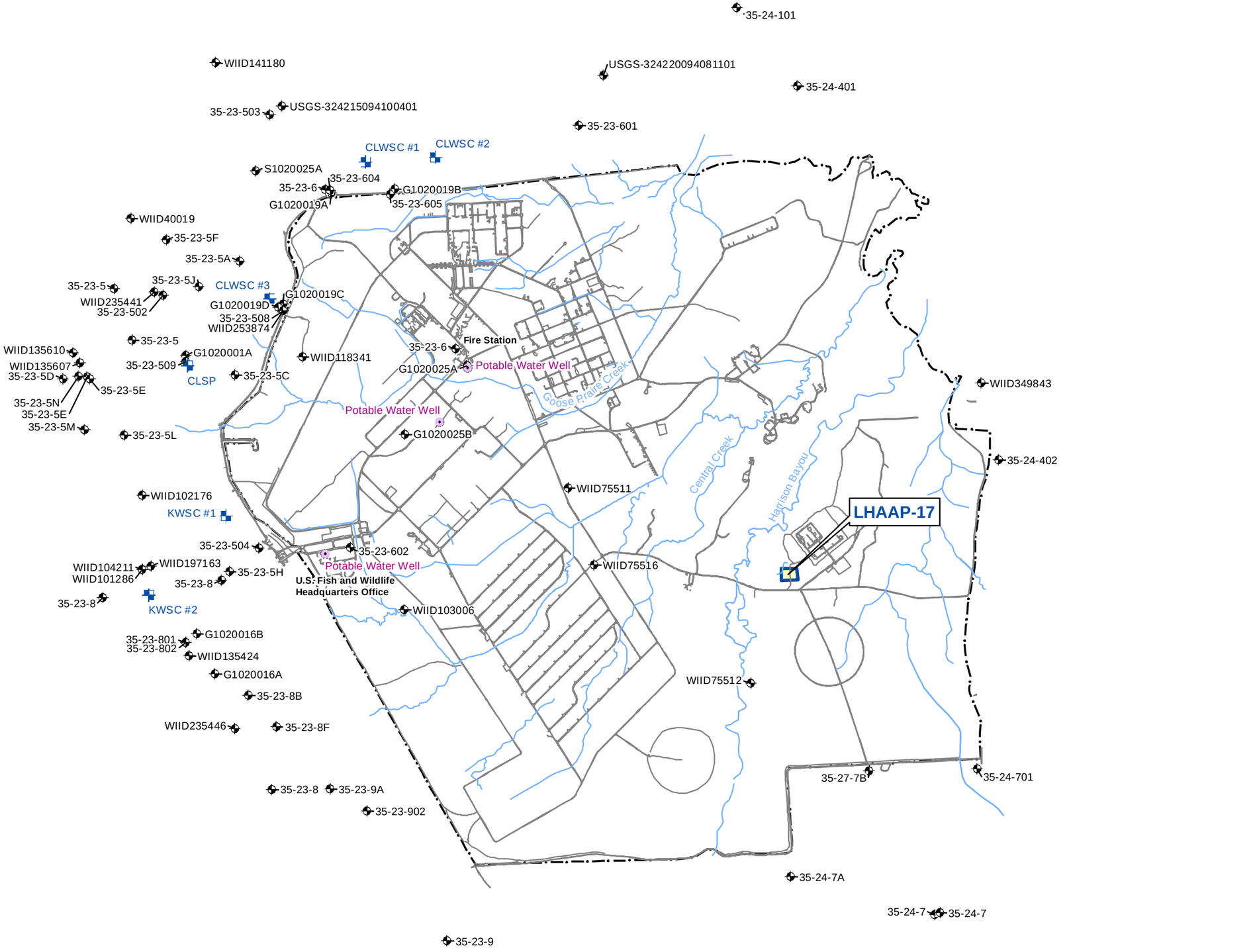

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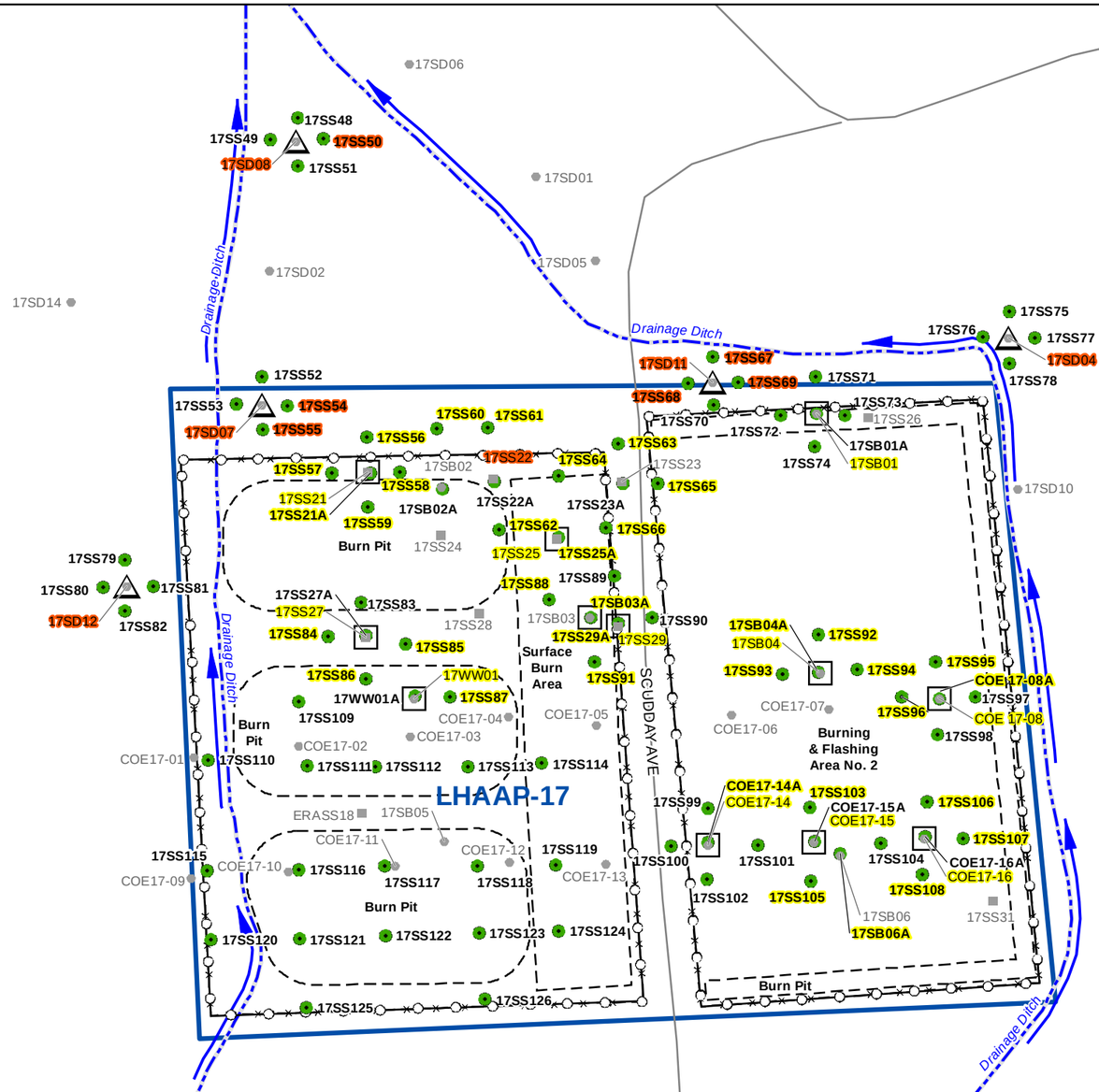
Figure 2-3

Drinking Water Supply Well Location Map
LHAAP-17
Remedial Design/Remedial Action Work Plan
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\DrinkingWaterSupplyWellLocation.mxd



Hstorical Soil Sample Location

Historical Surface Soil/Sediment Location

2018 PDI Soil Sample Location

Historical Sample location with contamination that poses Ecological Risk.

Historical Sample location with contamination that poses Human Health Risk (for soil to groundwater).

Fence Line

BURN_PITS

Surface Water Flow Direction

Drainage Ditch

Road

Site Boundary

17SS64 = Sample location where explosive concentrations in samples from one or more depths exceeded the human health cleanup level from the Final ROD (AECOM 2016)

17SS50 = Sample location where the barium concentration exceeded the cleanup levels for ecological risk in surface soil from the Final ROD (AECOM 2016)

Note: The soil sample analytical results for the highlighted locations shown on the map are provided on **Table 3-1**.

N

0 40 80 Feet

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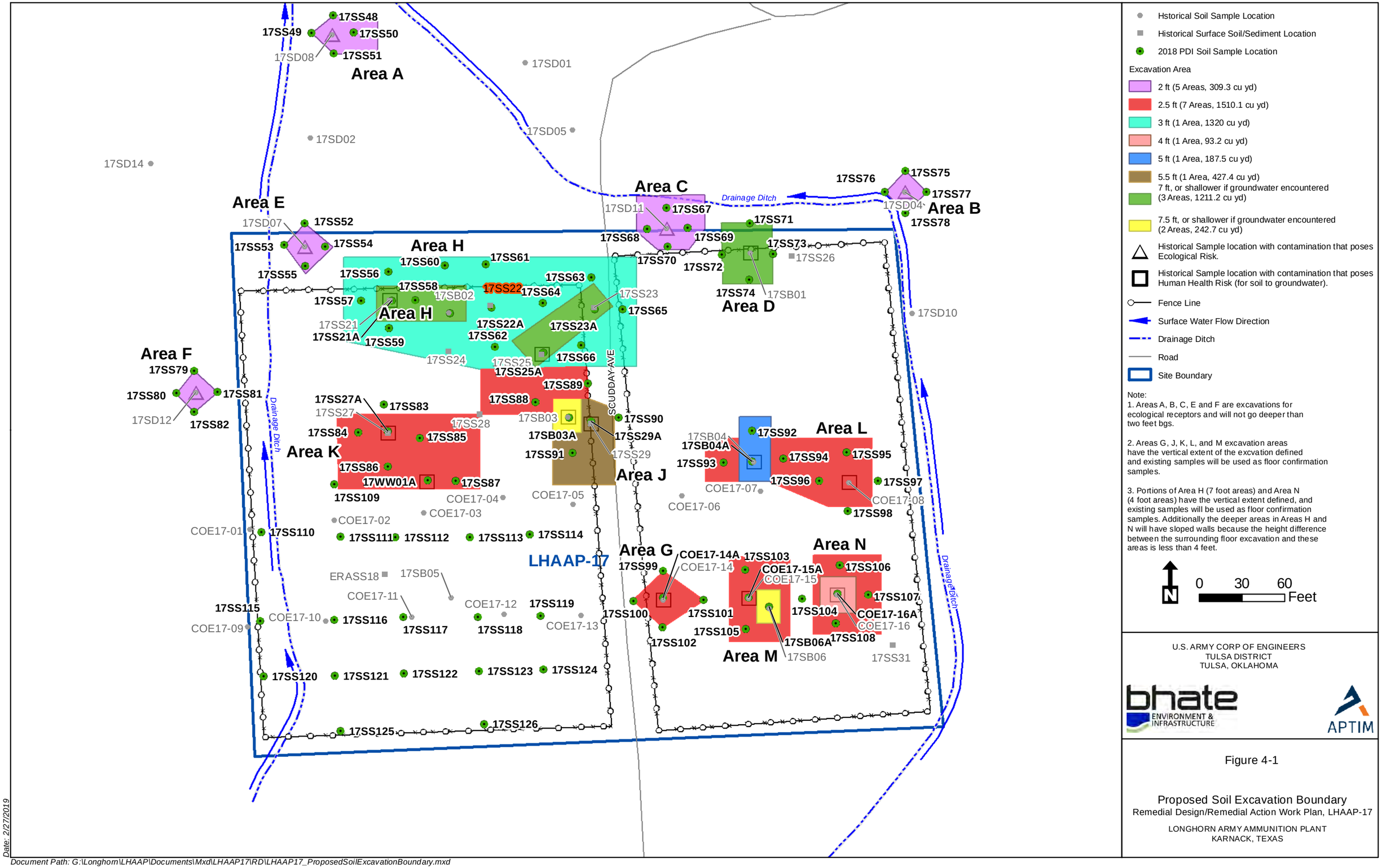
Figure 3-1

Soil Sample Locations with Concentrations Exceeding the Cleanup Levels
LHAAP-17
Remedial Design/Remedial Action Work Plan

Longhorn Army Ammunition Plant
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_SoilAnalyticalExceedances.mxd



Hstorical Soil Sample Location

Historical Surface Soil/Sediment Location

2018 PDI Soil Sample Location

Excavation Area

2 ft (5 Areas, 309.3 cu yd)

2.5 ft (7 Areas, 1510.1 cu yd)

3 ft (1 Area, 1320 cu yd)

4 ft (1 Area, 93.2 cu yd)

5 ft (1 Area, 187.5 cu yd)

5.5 ft (1 Area, 427.4 cu yd)
7 ft, or shallower if groundwater encountered
(3 Areas, 1211.2 cu yd)

7.5 ft, or shallower if groundwater encountered
(2 Areas, 242.7 cu yd)

Historical Sample location with contamination that poses Ecological Risk.

Historical Sample location with contamination that poses Human Health Risk (for soil to groundwater).

Fence Line

Surface Water Flow Direction

Drainage Ditch

Road

Site Boundary

Note:
1. Areas A, B, C, E and F are excavations for ecological receptors and will not go deeper than two feet bgs.

2. Areas G, J, K, L, and M excavation areas have the vertical extent of the excvation defined and existing samples will be used as floor confirmation samples.

3. Portions of Area H (7 foot areas) and Area N (4 foot areas) have the vertical extent defined, and existing samples will be used as floor confirmation samples. Additionally the deeper areas in Areas H and N will have sloped walls because the height difference between the surrounding floor excavation and these areas is less than 4 feet.

N

0 30 60 Feet

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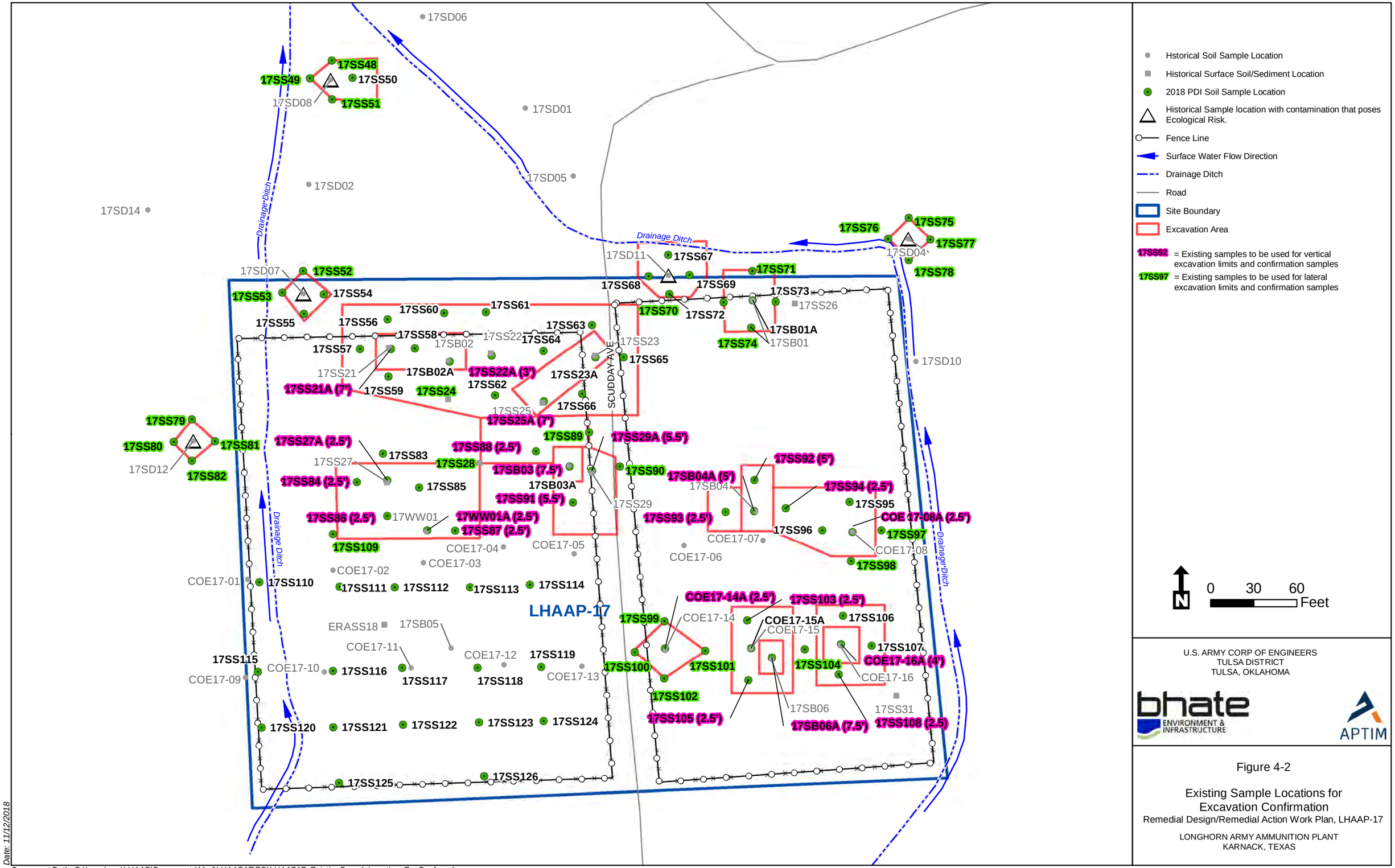
Figure 4-1

Proposed Soil Excavation Boundary
Remedial Design/Remedial Action Work Plan, LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_ProposedSoilExcavationBoundary.mxd



Hstorical Soil Sample Location

Historical Surface Soil/Sediment Location

2018 PDI Soil Sample Location

Historical Sample location with contamination that poses Ecological Risk.

Fence Line

Surface Water Flow Direction

Drainage Ditch

Road

Site Boundary

Excavation Area

17SS92 = Existing samples to be used for vertical excavation limits and confirmation samples

17SS97 = Existing samples to be used for lateral excavation limits and confirmation samples

N

0 30 60 Feet

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Figure 4-2

Existing Sample Locations for Excavation Confirmation

Remedial Design/Remedial Action Work Plan, LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 11/12/2018

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_ExistingSampleLocationsExcConf.mxd

18WW10		
Sample Date	9/25/2009	11/15/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	**52**

MW-10	
Sample Date	12/11/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

MW-16	
Sample Date	12/8/2017
TCE	**300**
1,1-DCE	3.6
1,2-DCA	**23**
Perchlorate	ND

120	
Sample Date	12/14/2017
TCE	**27,000**
1,1-DCE	**250**
1,2-DCA	**110**
CIS-1,2-DCE	**3,900**
VC	**260**
Perchlorate	**65,000**

MW-17	
Sample Date	12/11/2017
TCE	NA
1,1-DCE	NA
1,2-DCA	NA
Perchlorate	ND

MW-9	
Sample Date	12/13/2017
TCE	**930**
1,1-DCE	ND
1,2-DCA	0.82 J
Perchlorate	**44**

17WW11		
Sample Date	2/26/2009	11/14/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	ND

17WW20	
Sample Date	5/8/2018
TCE	1.6
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

17WW12			
Sample Date	3/30/2009	11/16/2017	2/15/2018
TCE	ND	dry	ND
1,1-DCE	ND		ND
1,2-DCA	ND		ND
Perchlorate	**990**		ND

MW-8	
Sample Date	12/12/2017
TCE	**270**
1,1-DCE	ND
1,2-DCA	4
Perchlorate	**5,500**

MW-7	
Sample Date	12/13/2017
TCE	**1,600**
1,1-DCE	ND
1,2-DCA	**17**
Perchlorate	**15,000**

17WW06		
Sample Date	3/5/2009	11/16/2017
TCE	**176**	**260**
1,1-DCE	**8.5**	**7.6**
1,2-DCA	**5.68**	**8.4**
Perchlorate	**74,000**	**110,000**

MW-18	
Sample Date	12/11/2017
TCE	4.8
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

17WW10		
Sample Date	2/16/2009	11/15/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	1.6

17WW02		
Sample Date	3/5/2009	11/15/2017
TCE	**867**	**6.2**
1,1-DCE	6.22	ND
1,2-DCA	**34.5**	3.3
Perchlorate	**160,000**	**2,500**

MW-19	
Sample Date	12/12/2017
TCE	3.2
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

MW-20	
Sample Date	12/14/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	1.9 J

18CPTMW22R	
Sample Date	12/14/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	8.3

17WW19	
Sample Date	1/15/2018
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

130		
Sample Date	3/4/2009	11/14/2017
TCE	**31.1**	2.1
1,1-DCE	ND	ND
1,2-DCA	4.29	ND
Perchlorate	**1,700**	2.5

17WW01		
Sample Date	3/4/2009	11/14/2017
TCE	**6,090**	**6,100**
1,1-DCE	**70**	**240**
1,2-DCA	**35.8**	**87**
CIS-1,2-DCE	--	**3,700**
VC	--	**43**
Perchlorate	**56,000**	ND

17WW13		
Sample Date	3/3/2009	11/14/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	ND

17WW14		
Sample Date	2/25/2009	11/14/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	2.5 J

17WW08		
Sample Date	2/25/2009	11/14/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	ND

17WW04		
Sample Date	3/2/2009	11/16/2017
TCE	0.914J	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	ND

17WW03		
Sample Date	3/5/2009	11/14/2017
TCE	**12.8**	**5.3**
1,1-DCE	ND	ND
1,2-DCA	0.26J	ND
Perchlorate	ND	ND

18WW14	
Sample Date	11/16/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

C-07	
Sample Date	11/16/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	4.4

LHAAP-17

Drainage Ditch

Drainage Ditch

17

17

17

5

AVE "Q"

LONG POINT RD

ROBERT AVE

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- LHAAP-17 2009 Perchlorate Contour (PCL = 17 µg/L)
- LHAAP-17 2017-2018 Perchlorate Contour (PCL = 17 µg/L)
- LHAAP-18/24 December 2017 Perchlorate Contour (PCL = 17 µg/L) (Bhate 2018a)
- LHAAP-18/24 December 2017 TCE Contour (MCL = 5 µg/L) (Bhate (2018a)
- Road
- Surface Water Flow Direction
- Drainage Ditch
- Site Boundary

Notes:
1. All concentrations are reported in microgram per liter (µg/L).
2. ND - non detect; detection limit below MCL/PCL
   NA - not analyzed
3. Highlighted concentrations indicate levels above cleanup
4. TCE - trichloroethene (MCL = 5 µg/L)
5. 1,1-DCE - 1,1-dichloroethene (MCL = 7 µg/L)
6. 1,2-DCA - 1,2-dichloroethane (MCL = 5 µg/L)
7. cis-1,2-DCE - cis-1,2-dichloroethene (MCL = 70 µg/L)
8. VC - Vinyl Chloride (MCL = 2 µg/L)
9. PCL - Texas Risk Reduction Program Protective Concentration Level
10. MCL - Safe Drinking Water Act Maximum Contaminated Level
11. The LHAAP-17 2017-2018 Perchlorate contour is based on data collected between November 2017 and May 2018.
12. The LHAAP-18/24 December 2017 TCE and Perchlorate contours are from the Draft Quarterly Evaluation Report, 4th Quarter (October-December) 2017 (Bhate 2018a).

N

0 100 200 Feet

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Figure 5-1

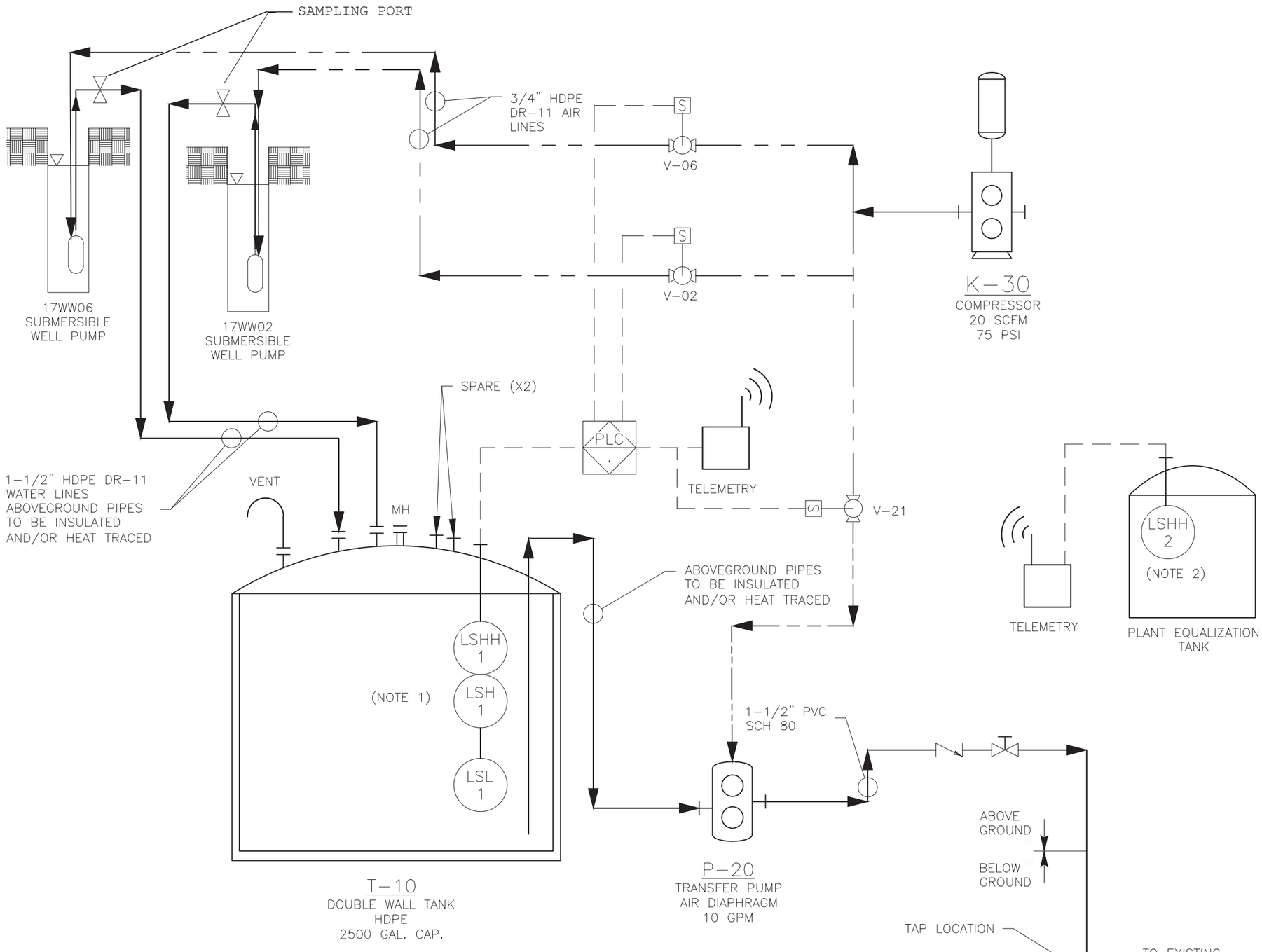
COC Concentrations Detected in Shallow Groundwater - 2009 and 2017

Remedial Design / Remedial Action Work Plan
LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 8/27/2018

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\PDI Report\LHAAP17_COC_ShWater_2009_2017.mxd



LEGEND:

- WATER LINE
- AIR LINE
- SIGNAL/COMMUNICATION LINE
- S — SOLENOID VALVE
- HAND VALVE
- CHECK VALVE
- LSHH X — LEVEL SWITCH HIGH-HIGH
- LSH X — LEVEL SWITCH HIGH
- LSL X — LEVEL SWITCH LOW

HDPE	HIGH DENSITY POLYETHYLENE
PVC	POLYVINYL CHLORIDE
SCFM	STANDARD CUBIC FEET PER MINUTE
PSI	POUNDS PER SQUARE INCH
GPM	GALLONS PER MINUTE
MH	MANHOLE

NOTES:

1. LSHH1 CLOSES V-02 AND V-06
   LSH1 OPENS V-21
   LSL1 CLOSES V-21
2. LSHH2 CLOSES V-21
3. 17WW01 WILL BE ADDED AS AN EXTRACTION WELL USING THE SAME DESIGN AS 17WW02 AND 17WW06 IF THE BASELINE SAMPLE PERCHLORATE CONCENTRATION EXCEEDS 20,000 MICROGRAMS PER LITER

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FIGURE 5-2

Groundwater Extraction Process Flow Diagram
Remedial Design / Remedial Action Work Plan
LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

File: 501032-PFD1.dwg
Plot Date/Time: Nov 09, 2018 - 10:39am
Plotted By: samantha.bentley

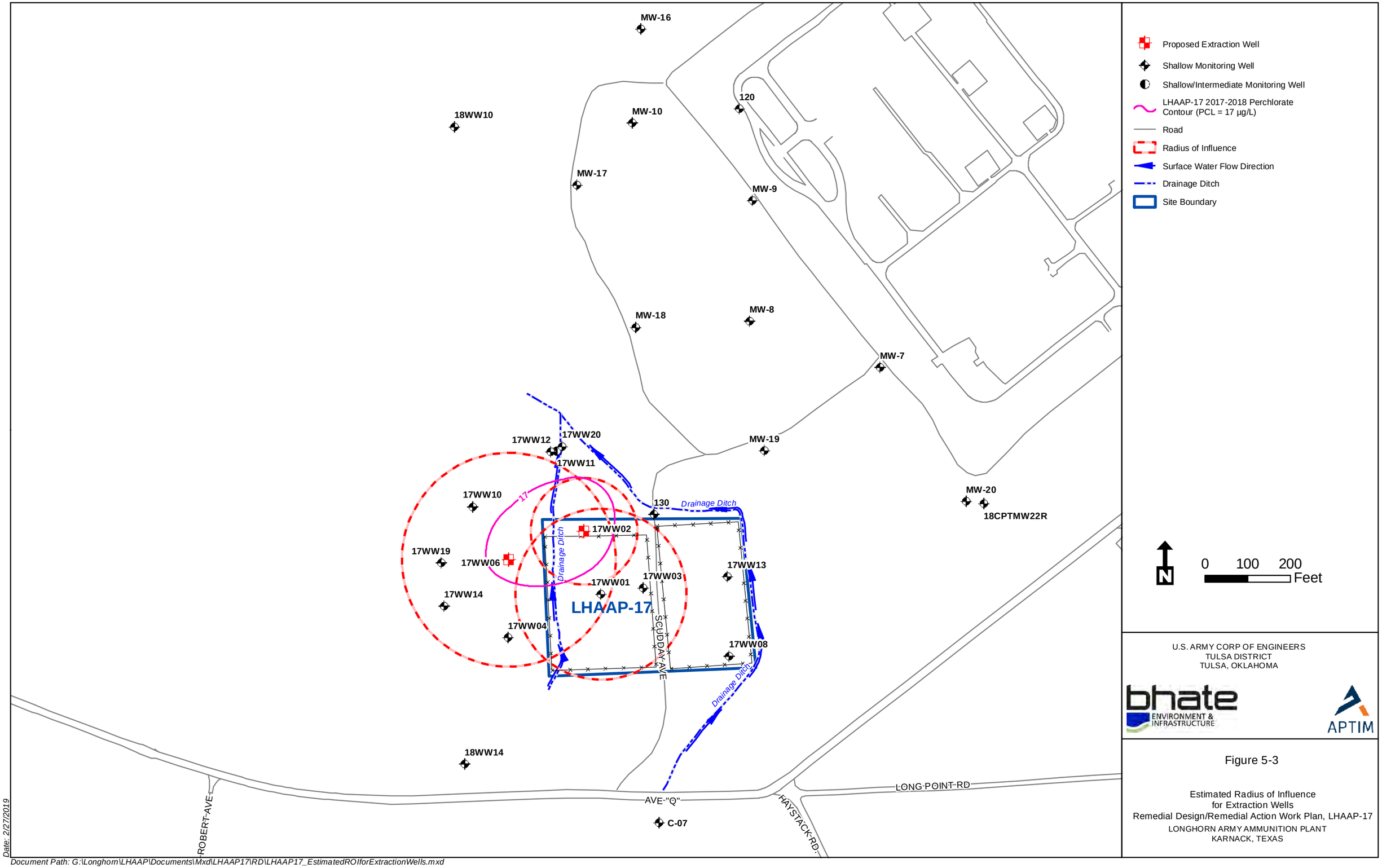

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Figure 5-3

Estimated Radius of Influence
for Extraction Wells
Remedial Design/Remedial Action Work Plan, LHAAP-17
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_EstimatedROIforExtractionWells.mxd

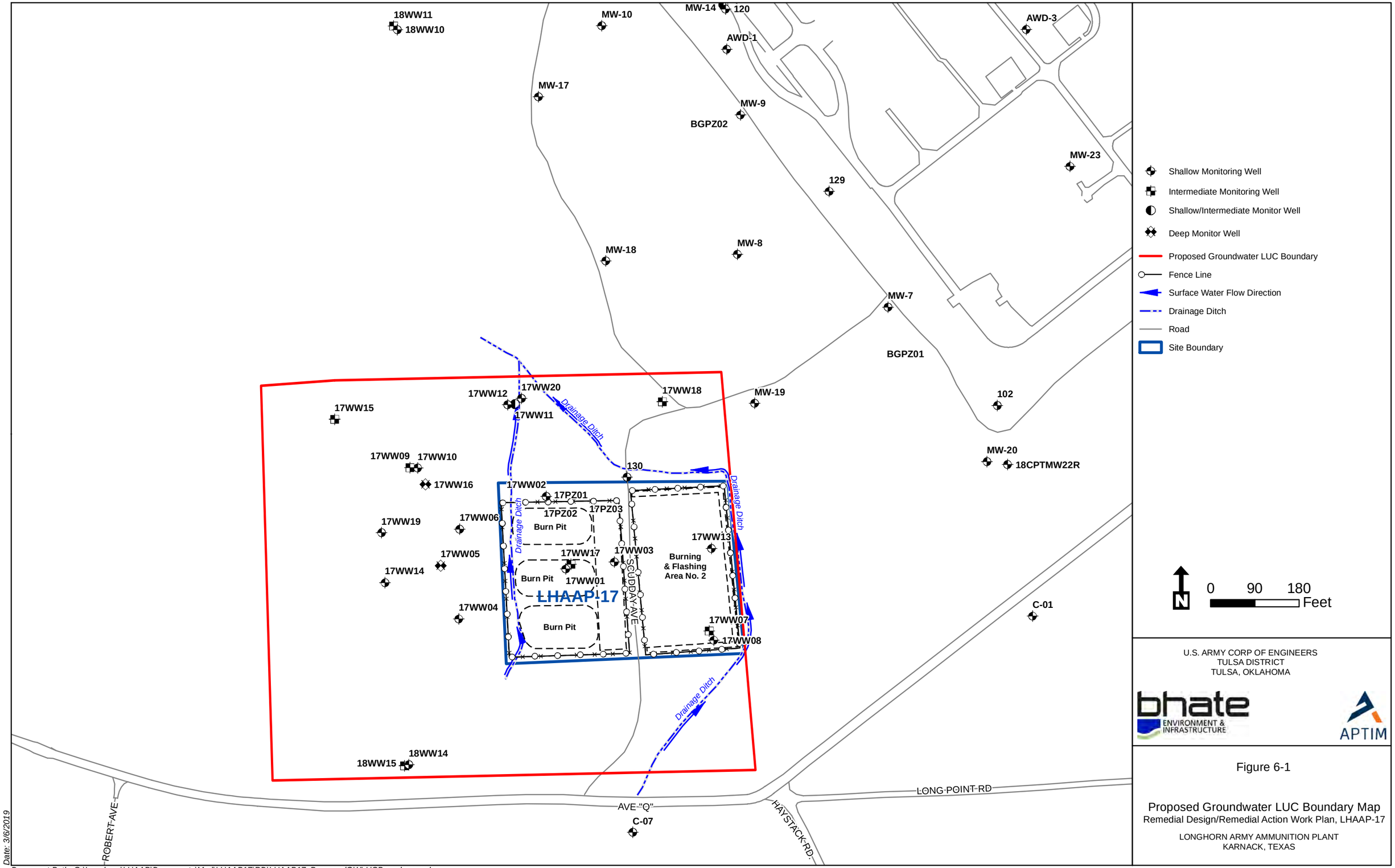

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Figure 6-1

Proposed Groundwater LUC Boundary Map
Remedial Design/Remedial Action Work Plan, LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 3/6/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_ProposedGWLUCBoundary.mxd

Note:
17WW02 and 17WW06 are the planned extraction wells, but 17WW01 may be added as an extraction well based on the results of the baseline sampling discussed in Section 5.5

N

0 80 160 320
Feet

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

APTIM

bhate ENVIRONMENT & INFRASTRUCTURE

FIGURE 7-1

GROUNDWATER EXTRACTION SYSTEM LAYOUT

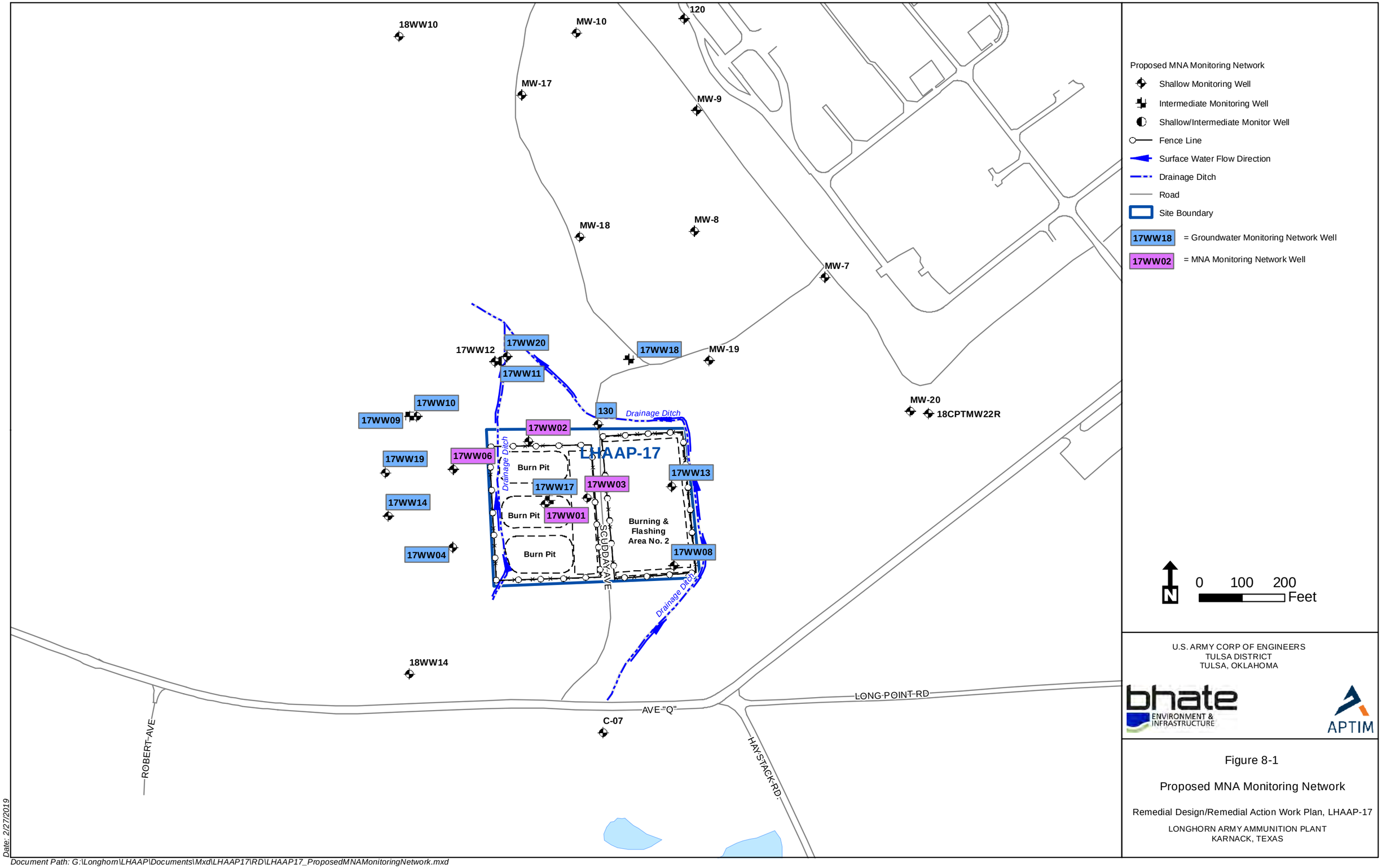
REMEDIAL DESIGN / REMEDIAL ACTION

WORK PLAN

LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

File: 501032-PFD1.dwg
Plot Date/Time: Nov 01, 2018 - 5:14pm
Plotted By: samantha.bentley



U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

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Figure 8-1

Proposed MNA Monitoring Network

Remedial Design/Remedial Action Work Plan, LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_ProposedMNAMonitoringNetwork.mxd

Appendix A

Analytical Data Reports from August 2018 Soil Samples

10450 Stancliff Rd. Suite 210
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September 04, 2018

Sharon Pennington
Aptim Environmental & Infrastucture, Inc.
2500 City West Blvd., Suite 1700
Houston, TX 77042

Work Order: **HS18080516**

Laboratory Results for: **Longhorn Army Ammunition Plant LHAAP-17**

Dear Sharon,

ALS Environmental received 10 sample(s) on Aug 10, 2018 for the analysis presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested. Results are expressed as "as received" unless otherwise noted.

QC sample results for this data met EPA or laboratory specifications except as noted in the Case Narrative or as noted with qualifiers in the QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained by ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

If you have any questions regarding this report, please feel free to call me.

Sincerely,

Generated By: JUMOKE.LAWAL
RJ Modashia
Project Manager

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Work Order: HS18080516

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18080516-01	17SS67-0.0-0.5	Soil		09-Aug-2018 09:45	10-Aug-2018 08:45	☐
HS18080516-02	17SS68-0.0-0.5	Soil		09-Aug-2018 09:55	10-Aug-2018 08:45	☐
HS18080516-03	17SS69-0.0-0.5	Soil		09-Aug-2018 10:05	10-Aug-2018 08:45	☐
HS18080516-04	17SS70-0.0-0.5	Soil		09-Aug-2018 10:15	10-Aug-2018 08:45	☐
HS18080516-05	17SS71-0.0-2.0	Soil		09-Aug-2018 11:10	10-Aug-2018 08:45	☐
HS18080516-06	17SS71-5.0-7.0	Soil		09-Aug-2018 13:20	10-Aug-2018 08:45	☐
HS18080516-07	17SS72-0.0-2.0	Soil		09-Aug-2018 11:20	10-Aug-2018 08:45	☐
HS18080516-08	17SS73-0.0-2.0	Soil		09-Aug-2018 11:30	10-Aug-2018 08:45	☐
HS18080516-09	17SS74-0.0-2.0	Soil		09-Aug-2018 11:40	10-Aug-2018 08:45	☐
HS18080516-10	17SS74-5.0-7.0	Soil		09-Aug-2018 13:30	10-Aug-2018 08:45	☐

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc. **CASE NARRATIVE**
Project: Longhorn Army Ammunition Plant LHAAP-17
Work Order: HS18080516

HPLC by Method SW8330

Batch ID: 131497

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

Metals by Method SW6020

Batch ID: 131368

Sample ID: HS18080501-05MS

- MS and MSD are for an unrelated sample

WetChemistry by Method ASTM D2216

Batch ID: R321861

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS67-0.0-0.5
Collection Date: 09-Aug-2018 09:45

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-01
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**280**		**0.322**	**1.07**	**5.37**	**mg/Kg-dry**	10	16-Aug-2018 15:46
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**11.5**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS68-0.0-0.5
Collection Date: 09-Aug-2018 09:55

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-02
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**4,480**		**3.63**	**12.1**	**60.4**	**mg/Kg-dry**	100	16-Aug-2018 15:48
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**21.3**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS69-0.0-0.5
Collection Date: 09-Aug-2018 10:05

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-03
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**252**		**0.338**	**1.13**	**5.64**	**mg/Kg-dry**	10	16-Aug-2018 15:50
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**15.5**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client:	Aptim Environmental & Infrastucture, Inc.	**ANALYTICAL REPORT**
Project:	Longhorn Army Ammunition Plant LHAAP-17	WorkOrder:HS18080516
Sample ID:	17SS70-0.0-0.5	Lab ID:HS18080516-04
Collection Date:	09-Aug-2018 10:15	Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**120**		**0.0333**	**0.111**	**0.555**	**mg/Kg-dry**	1	16-Aug-2018 15:02
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**13.6**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS71-0.0-2.0
Collection Date: 09-Aug-2018 11:10

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-05
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
EXPLOSIVES BY SW8330B	**Method:SW8330**					Prep:SW8330 / 15-Aug-2018		Analyst: NPI
2,4,6-Trinitrotoluene	28.1	U	5.58	28.1	67.5	ug/Kg-dry	1	16-Aug-2018 11:56
2,4-Dinitrotoluene	28.1	U	4.99	28.1	67.5	ug/Kg-dry	1	16-Aug-2018 11:56
2,6-Dinitrotoluene	28.1	U	12.1	28.1	67.5	ug/Kg-dry	1	16-Aug-2018 11:56
Surr: 1,2-Dinitrobenzene	*77.9*			**0**	*50-150*	*%REC*	*1*	*16-Aug-2018 11:56*
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**12.8**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS71-5.0-7.0
Collection Date: 09-Aug-2018 13:20

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-06
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
EXPLOSIVES BY SW8330B	**Method:SW8330**					Prep:SW8330 / 15-Aug-2018		Analyst: NPI
2,4,6-Trinitrotoluene	28.8	U	5.71	28.8	69.1	ug/Kg-dry	1	16-Aug-2018 12:32
2,4-Dinitrotoluene	28.8	U	5.11	28.8	69.1	ug/Kg-dry	1	16-Aug-2018 12:32
2,6-Dinitrotoluene	28.8	U	12.4	28.8	69.1	ug/Kg-dry	1	16-Aug-2018 12:32
Surr: 1,2-Dinitrobenzene	*76.2*			**0**	*50-150*	*%REC*	*1*	*16-Aug-2018 12:32*
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**16.9**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS72-0.0-2.0
Collection Date: 09-Aug-2018 11:20

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-07
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
EXPLOSIVES BY SW8330B	**Method:SW8330**					Prep:SW8330 / 15-Aug-2018		Analyst: NPI
2,4,6-Trinitrotoluene	29.0	U	5.75	29.0	69.5	ug/Kg-dry	1	16-Aug-2018 13:08
2,4-Dinitrotoluene	29.0	U	5.15	29.0	69.5	ug/Kg-dry	1	16-Aug-2018 13:08
2,6-Dinitrotoluene	29.0	U	12.5	29.0	69.5	ug/Kg-dry	1	16-Aug-2018 13:08
Surr: 1,2-Dinitrobenzene	*70.8*			**0**	*50-150*	*%REC*	*1*	*16-Aug-2018 13:08*
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**15.0**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS73-0.0-2.0
Collection Date: 09-Aug-2018 11:30

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-08
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
EXPLOSIVES BY SW8330B	**Method:SW8330**					Prep:SW8330 / 15-Aug-2018		Analyst: NPI
2,4,6-Trinitrotoluene	28.2	U	5.60	28.2	67.8	ug/Kg-dry	1	16-Aug-2018 13:44
2,4-Dinitrotoluene	28.2	U	5.01	28.2	67.8	ug/Kg-dry	1	16-Aug-2018 13:44
2,6-Dinitrotoluene	28.2	U	12.2	28.2	67.8	ug/Kg-dry	1	16-Aug-2018 13:44
Surr: 1,2-Dinitrobenzene	*73.8*			**0**	*50-150*	*%REC*	*1*	*16-Aug-2018 13:44*
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**11.9**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS74-0.0-2.0
Collection Date: 09-Aug-2018 11:40

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-09
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
EXPLOSIVES BY SW8330B	**Method:SW8330**					Prep:SW8330 / 15-Aug-2018		Analyst: NPI
2,4,6-Trinitrotoluene	26.8	U	5.32	26.8	64.4	ug/Kg-dry	1	16-Aug-2018 14:19
2,4-Dinitrotoluene	26.8	U	4.76	26.8	64.4	ug/Kg-dry	1	16-Aug-2018 14:19
2,6-Dinitrotoluene	26.8	U	11.6	26.8	64.4	ug/Kg-dry	1	16-Aug-2018 14:19
Surr: 1,2-Dinitrobenzene	*75.1*			**0**	*50-150*	*%REC*	*1*	*16-Aug-2018 14:19*
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**10.4**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
Sample ID: 17SS74-5.0-7.0
Collection Date: 09-Aug-2018 13:30

ANALYTICAL REPORT
WorkOrder:HS18080516
Lab ID:HS18080516-10
Matrix:Soil

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
EXPLOSIVES BY SW8330B	**Method:SW8330**					Prep:SW8330 / 15-Aug-2018		Analyst: NPI
2,4,6-Trinitrotoluene	31.5	U	6.25	31.5	75.6	ug/Kg-dry	1	16-Aug-2018 14:55
2,4-Dinitrotoluene	31.5	U	5.59	31.5	75.6	ug/Kg-dry	1	16-Aug-2018 14:55
2,6-Dinitrotoluene	31.5	U	13.6	31.5	75.6	ug/Kg-dry	1	16-Aug-2018 14:55
Surr: 1,2-Dinitrobenzene	*76.3*			**0**	*50-150*	*%REC*	*1*	*16-Aug-2018 14:55*
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**22.9**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	16-Aug-2018 12:06

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp

Date: 04-Sep-18

WEIGHT LOG

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
WorkOrder: HS18080516

Batch ID: 131368 **Method:** METALS BY SW6020A **Prep:** 3050_I_LOW

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18080516-01	1	0.5258	50 (mL)	95.09
HS18080516-02	1	0.5257	50 (mL)	95.11
HS18080516-03	1	0.525	50 (mL)	95.24
HS18080516-04	1	0.5211	50 (mL)	95.95

Batch ID: 131497 **Method:** EXPLOSIVES BY SW8330B **Prep:** 8330_SPR

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18080516-05	1	2.04	10 (mL)	4.902
HS18080516-06	1	2.09	10 (mL)	4.785
HS18080516-07	1	2.03	10 (mL)	4.926
HS18080516-08	1	2.01	10 (mL)	4.975
HS18080516-09	1	2.08	10 (mL)	4.808
HS18080516-10	1	2.06	10 (mL)	4.854

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
WorkOrder: HS18080516

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID 131368	**Test Name :** METALS BY SW6020A			**Matrix:** Soil		
HS18080516-01	17SS67-0.0-0.5	09 Aug 2018 09:45		10 Aug 2018 09:51	16 Aug 2018 15:46	10
HS18080516-02	17SS68-0.0-0.5	09 Aug 2018 09:55		10 Aug 2018 09:51	16 Aug 2018 15:48	100
HS18080516-03	17SS69-0.0-0.5	09 Aug 2018 10:05		10 Aug 2018 09:51	16 Aug 2018 15:50	10
HS18080516-04	17SS70-0.0-0.5	09 Aug 2018 10:15		10 Aug 2018 09:51	16 Aug 2018 15:02	1
Batch ID 131497	**Test Name :** EXPLOSIVES BY SW8330B			**Matrix:** Soil		
HS18080516-05	17SS71-0.0-2.0	09 Aug 2018 11:10		15 Aug 2018 11:01	16 Aug 2018 11:56	1
HS18080516-06	17SS71-5.0-7.0	09 Aug 2018 13:20		15 Aug 2018 11:01	16 Aug 2018 12:32	1
HS18080516-07	17SS72-0.0-2.0	09 Aug 2018 11:20		15 Aug 2018 11:01	16 Aug 2018 13:08	1
HS18080516-08	17SS73-0.0-2.0	09 Aug 2018 11:30		15 Aug 2018 11:01	16 Aug 2018 13:44	1
HS18080516-09	17SS74-0.0-2.0	09 Aug 2018 11:40		15 Aug 2018 11:01	16 Aug 2018 14:19	1
HS18080516-10	17SS74-5.0-7.0	09 Aug 2018 13:30		15 Aug 2018 11:01	16 Aug 2018 14:55	1
Batch ID R321861	**Test Name :** MOISTURE - ASTM D2216			**Matrix:** Soil		
HS18080516-01	17SS67-0.0-0.5	09 Aug 2018 09:45			16 Aug 2018 12:06	1
HS18080516-02	17SS68-0.0-0.5	09 Aug 2018 09:55			16 Aug 2018 12:06	1
HS18080516-03	17SS69-0.0-0.5	09 Aug 2018 10:05			16 Aug 2018 12:06	1
HS18080516-04	17SS70-0.0-0.5	09 Aug 2018 10:15			16 Aug 2018 12:06	1
HS18080516-05	17SS71-0.0-2.0	09 Aug 2018 11:10			16 Aug 2018 12:06	1
HS18080516-06	17SS71-5.0-7.0	09 Aug 2018 13:20			16 Aug 2018 12:06	1
HS18080516-07	17SS72-0.0-2.0	09 Aug 2018 11:20			16 Aug 2018 12:06	1
HS18080516-08	17SS73-0.0-2.0	09 Aug 2018 11:30			16 Aug 2018 12:06	1
HS18080516-09	17SS74-0.0-2.0	09 Aug 2018 11:40			16 Aug 2018 12:06	1
HS18080516-10	17SS74-5.0-7.0	09 Aug 2018 13:30			16 Aug 2018 12:06	1

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
WorkOrder: HS18080516

QC BATCH REPORT

Batch ID: 131497 **Instrument: HPLC3** **Method: SW8330**

MBLK Sample ID: **MBLK-131497** Units: **ug/Kg** Analysis Date: **16-Aug-2018 18:30**
Client ID: Run ID: **HPLC3_321848** SeqNo: **4695684** PrepDate: **15-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
2,4,6-Trinitrotoluene	25.0	60.0								U
2,4-Dinitrotoluene	25.0	60.0								U
2,6-Dinitrotoluene	25.0	60.0								U
Surr: 1,2-Dinitrobenzene	*978.6*	*60.0*	*1250*	*0*	*78.3*	*50 - 150*				

MBLK Sample ID: **MBLK-131497** Units: **ug/Kg** Analysis Date: **16-Aug-2018 18:30**
Client ID: Run ID: **HPLC3_321849** SeqNo: **4695693** PrepDate: **15-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
2,4,6-Trinitrotoluene	25.0	60.0								U
2,4-Dinitrotoluene	25.0	60.0								U
2,6-Dinitrotoluene	25.0	60.0								U
Surr: 1,2-Dinitrobenzene	*978.6*	*60.0*	*1250*	*0*	*78.3*	*50 - 150*				

LCS Sample ID: **LCS-131497** Units: **ug/Kg** Analysis Date: **16-Aug-2018 18:53**
Client ID: Run ID: **HPLC3_321848** SeqNo: **4695697** PrepDate: **15-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
2,4,6-Trinitrotoluene	1201	60.0	1250	0	96.1	75 - 125				
2,4-Dinitrotoluene	1200	60.0	1250	0	96.0	82 - 123				
2,6-Dinitrotoluene	1210	60.0	1250	0	96.8	86 - 119				
Surr: 1,2-Dinitrobenzene	*1243*	*60.0*	*1250*	*0*	*99.4*	*50 - 150*				

LCS Sample ID: **LCS-131497** Units: **ug/Kg** Analysis Date: **16-Aug-2018 18:53**
Client ID: Run ID: **HPLC3_321849** SeqNo: **4695698** PrepDate: **15-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
2,4,6-Trinitrotoluene	1201	60.0	1250	0	96.1	60 - 120				
2,4-Dinitrotoluene	1200	60.0	1250	0	96.0	60 - 120				
2,6-Dinitrotoluene	1210	60.0	1250	0	96.8	60 - 120				
Surr: 1,2-Dinitrobenzene	*1243*	*60.0*	*1250*	*0*	*99.4*	*50 - 150*				

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
WorkOrder: HS18080516

QC BATCH REPORT

Batch ID: 131497 **Instrument: HPLC3** **Method: SW8330**

MS Sample ID: **HS18080516-10MS** Units: **ug/Kg** Analysis Date: **16-Aug-2018 15:31**
Client ID: **17SS74-5.0-7.0** Run ID: **HPLC3_321848** SeqNo: **4695680** PrepDate: **15-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
2,4,6-Trinitrotoluene	1271	58.8	1225	0	104	75 - 125				
2,4-Dinitrotoluene	1299	58.8	1225	0	106	82 - 123				
2,6-Dinitrotoluene	1273	58.8	1225	0	104	86 - 119				
Surr: 1,2-Dinitrobenzene	*974.5*	*58.8*	*1225*	*0*	*79.5*	*50 - 150*				

MS Sample ID: **HS18080516-10MS** Units: **ug/Kg** Analysis Date: **16-Aug-2018 15:31**
Client ID: **17SS74-5.0-7.0** Run ID: **HPLC3_321849** SeqNo: **4695689** PrepDate: **15-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
2,4,6-Trinitrotoluene	1271	58.8	1225	0	104	60 - 120				
2,4-Dinitrotoluene	1299	58.8	1225	0	106	60 - 120				
2,6-Dinitrotoluene	1273	58.8	1225	0	104	60 - 120				
Surr: 1,2-Dinitrobenzene	*974.5*	*58.8*	*1225*	*0*	*79.5*	*50 - 150*				

MSD Sample ID: **HS18080516-10MSD** Units: **ug/Kg** Analysis Date: **16-Aug-2018 16:07**
Client ID: **17SS74-5.0-7.0** Run ID: **HPLC3_321848** SeqNo: **4695681** PrepDate: **15-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
2,4,6-Trinitrotoluene	1262	58.0	1208	0	105	75 - 125	1271	0.689	30	
2,4-Dinitrotoluene	1280	58.0	1208	0	106	82 - 123	1299	1.46	30	
2,6-Dinitrotoluene	1237	58.0	1208	0	102	86 - 119	1273	2.86	30	
Surr: 1,2-Dinitrobenzene	*1025*	*58.0*	*1208*	*0*	*84.9*	*50 - 150*	*974.5*	*5.07*	*30*	

MSD Sample ID: **HS18080516-10MSD** Units: **ug/Kg** Analysis Date: **16-Aug-2018 16:07**
Client ID: **17SS74-5.0-7.0** Run ID: **HPLC3_321849** SeqNo: **4695690** PrepDate: **15-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
2,4,6-Trinitrotoluene	1262	58.0	1208	0	105	60 - 120	1271	0.689	30	
2,4-Dinitrotoluene	1280	58.0	1208	0	106	60 - 120	1299	1.46	30	
2,6-Dinitrotoluene	1237	58.0	1208	0	102	60 - 120	1273	2.86	30	
Surr: 1,2-Dinitrobenzene	*1025*	*58.0*	*1208*	*0*	*84.9*	*50 - 150*	*974.5*	*5.07*	*30*	

The following samples were analyzed in this batch: HS18080516-05 HS18080516-06 HS18080516-07 HS18080516-08 HS18080516-09 HS18080516-10

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
WorkOrder: HS18080516

QC BATCH REPORT

Batch ID: 131368 **Instrument: ICPMS04** **Method: SW6020**

MBLK Sample ID: **MBLK-131368** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:25**
Client ID: Run ID: **ICPMS04_321797** SeqNo: **4695286** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	0.059	0.500								J

LCS Sample ID: **LCS-131368** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:28**
Client ID: Run ID: **ICPMS04_321797** SeqNo: **4695287** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	9.99	0.500	10	0	99.9	80 - 120				

MS Sample ID: **HS18080501-05MS** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:48**
Client ID: Run ID: **ICPMS04_321797** SeqNo: **4695296** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	88.29	0.469	9.381	66.31	234	75 - 125				SO

MSD Sample ID: **HS18080501-05MSD** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:50**
Client ID: Run ID: **ICPMS04_321797** SeqNo: **4695297** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	86.5	0.466	9.314	66.31	217	75 - 125	88.29	2.04	20	SO

PDS Sample ID: **HS18080501-05PDS** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:53**
Client ID: Run ID: **ICPMS04_321797** SeqNo: **4695298** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	74.61	0.469	9.377	66.31	88.6	75 - 125				O

SD Sample ID: **HS18080501-05SD** Units: **mg/Kg** Analysis Date: **16-Aug-2018 15:44**
Client ID: Run ID: **ICPMS04_321797** SeqNo: **4695307** PrepDate: **10-Aug-2018** DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Barium	66.37	2.34					66.31	0.0901	10	

The following samples were analyzed in this batch: HS18080516-01 HS18080516-02 HS18080516-03 HS18080516-04

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
WorkOrder: HS18080516

QC BATCH REPORT

Batch ID: R321861 **Instrument: Balance1** **Method: ASTM D2216**

DUP Sample ID: **HS18080516-10DUP** Units: **wt%** Analysis Date: **16-Aug-2018 12:06**
Client ID: **17SS74-5.0-7.0** Run ID: **Balance1_321861** SeqNo: **4696162** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Percent Moisture	21.4	0.0100					22.9	6.77	20	

The following samples were analyzed in this batch:

HS18080516-01	HS18080516-02	HS18080516-03	HS18080516-04
HS18080516-05	HS18080516-06	HS18080516-07	HS18080516-08
HS18080516-09	HS18080516-10		

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 04-Sep-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant LHAAP-17
WorkOrder: **HS18080516**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL/SDL

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitaion Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

ALS Group Houston, Corp Date: 04-Sep-18

CERTIFICATIONS,ACCREDITATIONS & LICENSES

Agency	Number	Expire Date
North Carolina	624-2018	31-Dec-2018
Arkansas	88-0356	27-Mar-2019
Texas	T10470231-18-21	30-Apr-2019
North Dakota	R193 2018-2019	30-Apr-2019
Illinois	004438	29-Jun-2019
Louisiana	03087	30-Jun-2019
Dept of Defense	L2231 Rev 3-30-2018	22-Dec-2018
Kentucky	123043 - 2018	30-Apr-2019
Kansas	E-10352 2018-2019	31-Jul-2019
Oklahoma	2018-156	31-Aug-2019

Date: 04-Sep-18

Sample Receipt Checklist

Client Name: CBI-Houston
Work Order: HS18080516

Date/Time Received: **10-Aug-2018 08:45**
Received by: **JRM**

Checklist completed by: *Jared R. Makan* eSignature — 10-Aug-2018 Date

Reviewed by: *RJ Modashia* eSignature — 10-Aug-2018 Date

Matrices: **Soil**

Carrier name: **ALS Courier**

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
TX1005 solids received in hermetically sealed vials?	Yes ☐	No ☐	N/A ☑
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Temperature(s)/Thermometer(s):	3.0c/2.6c UC/C	IR11	
Cooler(s)/Kit(s):	43306		
Date/Time sample(s) sent to storage:	08/10/2018 11:35		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑
pH adjusted?	Yes ☐	No ☐	N/A ☑
pH adjusted by:			

Login Notes:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

APTIM

Page 1 of 1

COC ID: 09-AUG2018-SO-ALSHT-080918 TURNAROUND TIME: normal RUSH:

PROJECT/CLIENT INFO				LABORATORY				OTHER INFO			
Facility Name	Longhorn AAP			Lab Name	ALS Laboratories			Email Invoice To	FedInvoices@CBIFederalServices.com		
Project Number	501032			Lab Contact	Sonia West						
	LHAAP-17			Email	Sonia.West@alsglobal.com			Email Report To	Sharon.Pennington@CBIFederalServices.com		
Address	1203-B East Grand Avenue			Address	10450 Stancliff Rd., Suite 210			Mail Reports To	Sharon Pennington		
	PMB 202							Address	2410 Cherahala Blvd.		
City	Marshall	State	TX	City	Houston	State	TX	City	Knoxville	State	TN
Postal Code	75670	Country	USA	Postal Code	77099	Country	USA	Postal Code	37932	Country	USA
Phone Number	713.243.7264			Phone Number	281.575.2132 or 281.530.5656						
Project Manager	Praveen Srivastav							Shipping Company	FedEx		

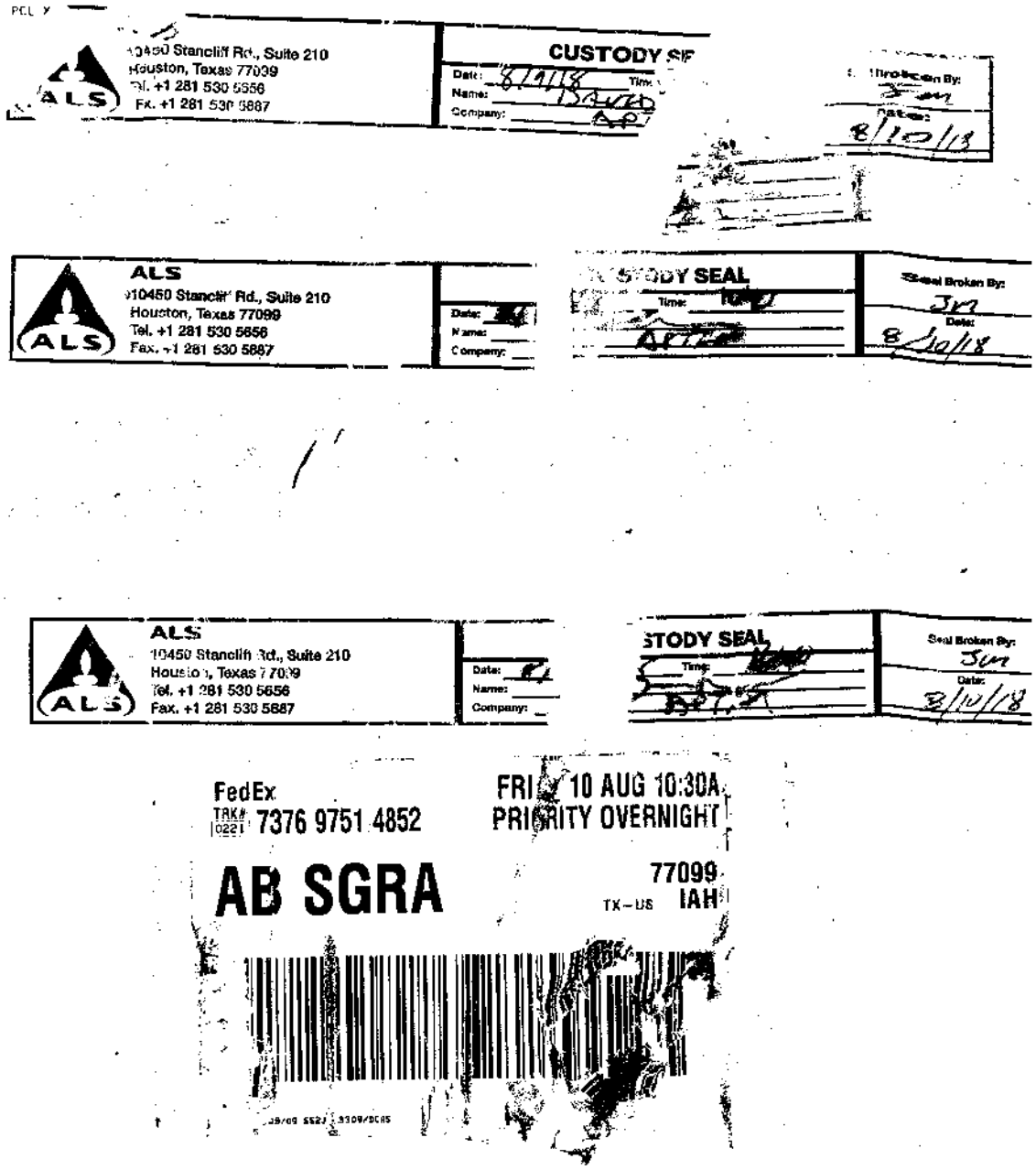
SAMPLE DETAILS / ANALYSIS REQUESTED

Sample ID	Location	Start Depth	End Depth	Depth Unit	Field Matrix	Date	Time (24hr)	# Of Cont.	Barium in Soil by Method 6020A	2,4-DNT & 2,6-DNT in Soil by Method 8330
17SS67-0.0-0.5	LHAAP-17	0	0.5	FT	SO	8/9/2018	0945	1	X	
17SS68-0.0-0.5	LHAAP-17	0	0.5	FT	SO	8/9/2018	0955	1	X	
17SS69-0.0-0.5	LHAAP-17	0	0.5	FT	SO	8/9/2018	1005	1	X	
17SS70-0.0-0.5	LHAAP-17	0	0.5	FT	SO	8/9/2018	1015	1	X	
17SS71-0.0-2.0	LHAAP-17	0	2	FT	SO	8/9/2018	1110	1		X
17SS71-5.0-7.0	LHAAP-17	5	7	FT	SO	8/9/2018	1320	1		X
17SS72-0.0-2.0	LHAAP-17	0	2	FT	SO	8/9/2018	1120	1		X
17SS73-0.0-2.0	LHAAP-17	0	2	FT	SO	8/9/2018	1130	1		X
17SS74-0.0-2.0	LHAAP-17	0	2	FT	SO	8/9/2018	1140	1		X
17SS74-5.0-7.0	LHAAP-17	5	7	FT	SO	8/9/2018	1330	1		X
17SS74-5.0-7.0-MS	LHAAP-17	5	7	FT	SO	8/9/2018	1330	1		X
17SS74-5.0-7.0-MSD	LHAAP-17	5	7	FT	SO	8/9/2018	1330	1		X

HS18080516
Aptim Environmental & Infrastucture, Inc.
Longhorn Army Ammunition Plant LHAAP-17

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
	David Rowan / APTIM	8/9/2018		
	[signature]	1636	J. Mahan	8/10/18 08:45

Cooler - 43306 1411
Temp - 3.0 CF-0.4


ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887
CUSTODY SEAL
Seal Broken By:
Date:
8/10/18
ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887
CUSTODY SEAL
Seal Broken By:
Date:
8/10/18
ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887
CUSTODY SEAL
Seal Broken By:
Date:
8/10/18
FedEx
TRK# 0221 7376 9751 4852
FRI 10 AUG 10:30A
PRIORITY OVERNIGHT
AB SGRA
77099
TX-US IAH

10450 Stancliff Rd. Suite 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887

August 20, 2018

Sharon Pennington
Aptim Environmental & Infrastucture, Inc.
2500 City West Blvd., Suite 1700
Houston, TX 77042

Work Order: **HS18080501**

Laboratory Results for: **Longhorn Army Ammunition Plant**

Dear Sharon,

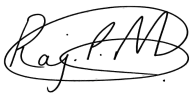
ALS Environmental received 5 sample(s) on Aug 09, 2018 for the analysis presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested. Results are expressed as "as received" unless otherwise noted.

QC sample results for this data met EPA or laboratory specifications except as noted in the Case Narrative or as noted with qualifiers in the QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained by ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

If you have any questions regarding this report, please feel free to call me.

Sincerely,



Generated By: DAYNA.FISHER
RJ Modashia
Project Manager

ALS Group Houston, Corp Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant
Work Order: HS18080501

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18080501-01	17SS75-0.0-0.5	Solid		08-Aug-2018 13:30	09-Aug-2018 08:40	☐
HS18080501-02	17SS75-0.0-0.5-FD	Solid		08-Aug-2018 13:30	09-Aug-2018 08:40	☐
HS18080501-03	17SS76-0.0-0.5	Solid		08-Aug-2018 13:40	09-Aug-2018 08:40	☐
HS18080501-04	17SS77-0.0-0.5	Solid		08-Aug-2018 13:50	09-Aug-2018 08:40	☐
HS18080501-05	17SS78-0.0-0.5	Solid		08-Aug-2018 14:00	09-Aug-2018 08:40	☐

ALS Group Houston, Corp Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant
Work Order: HS18080501

CASE NARRATIVE

Metals by Method SW6020

Batch ID: 131368

Sample ID: 17SS78-0.0-0.5 (HS18080501-05MS)

- The MS and/or MSD recovery was outside of the control; however, the result in the parent sample is greater than 4x the spike amount. Barium.

WetChemistry by Method ASTM D2216

Batch ID: R321965

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

ALS Group Houston, Corp

Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.

ANALYTICAL REPORT

Project: Longhorn Army Ammunition Plant

WorkOrder:HS18080501

Sample ID: 17SS75-0.0-0.5

Lab ID:HS18080501-01

Collection Date: 08-Aug-2018 13:30

Matrix:Solid

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**78.9**		**0.0310**	**0.103**	**0.516**	**mg/Kg-dry**	1	16-Aug-2018 14:30
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**5.73**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	17-Aug-2018 12:40

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp

Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.

ANALYTICAL REPORT

Project: Longhorn Army Ammunition Plant

WorkOrder:HS18080501

Sample ID: 17SS75-0.0-0.5-FD

Lab ID:HS18080501-02

Collection Date: 08-Aug-2018 13:30

Matrix:Solid

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**71.3**		**0.0307**	**0.102**	**0.512**	**mg/Kg-dry**	1	16-Aug-2018 14:32
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**5.54**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	17-Aug-2018 12:40

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp

Date: 20-Aug-18

ANALYTICAL REPORT

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant
Sample ID: 17SS76-0.0-0.5
Collection Date: 08-Aug-2018 13:40

WorkOrder:HS18080501
Lab ID:HS18080501-03
Matrix:Solid

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**88.1**		**0.0301**	**0.100**	**0.502**	**mg/Kg-dry**	1	16-Aug-2018 14:35
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**6.97**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	17-Aug-2018 12:40

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp

Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.

ANALYTICAL REPORT

Project: Longhorn Army Ammunition Plant

WorkOrder:HS18080501

Sample ID: 17SS77-0.0-0.5

Lab ID:HS18080501-04

Collection Date: 08-Aug-2018 13:50

Matrix:Solid

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**90.5**		**0.0317**	**0.106**	**0.528**	**mg/Kg-dry**	1	16-Aug-2018 14:37
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**9.53**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	17-Aug-2018 12:40

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp

Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.

ANALYTICAL REPORT

Project: Longhorn Army Ammunition Plant

WorkOrder:HS18080501

Sample ID: 17SS78-0.0-0.5

Lab ID:HS18080501-05

Collection Date: 08-Aug-2018 14:00

Matrix:Solid

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
METALS BY SW6020A	**Method:SW6020**					Prep:SW3050A / 10-Aug-2018		Analyst: JDE
Barium	**72.8**		**0.0309**	**0.103**	**0.515**	**mg/Kg-dry**	1	16-Aug-2018 14:39
MOISTURE - ASTM D2216	**Method:ASTM D2216**							Analyst: DFF
Percent Moisture	**8.91**		**0.0100**	**0.0100**	**0.0100**	**wt%**	1	17-Aug-2018 12:40

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp

Date: 20-Aug-18

WEIGHT LOG

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant
WorkOrder: HS18080501

Batch ID: 131368 **Method:** METALS BY SW6020A **Prep:** 3050_I_LOW

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18080501-01	1	0.5136	50 (mL)	97.35
HS18080501-02	1	0.5166	50 (mL)	96.79
HS18080501-03	1	0.5349	50 (mL)	93.48
HS18080501-04	1	0.5238	50 (mL)	95.46
HS18080501-05	1	0.5332	50 (mL)	93.77

ALS Group Houston, Corp Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant
WorkOrder: HS18080501

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID 131368	**Test Name :** METALS BY SW6020A			**Matrix:** Solid		
HS18080501-01	17SS75-0.0-0.5	08 Aug 2018 13:30		10 Aug 2018 09:51	16 Aug 2018 14:30	1
HS18080501-02	17SS75-0.0-0.5-FD	08 Aug 2018 13:30		10 Aug 2018 09:51	16 Aug 2018 14:32	1
HS18080501-03	17SS76-0.0-0.5	08 Aug 2018 13:40		10 Aug 2018 09:51	16 Aug 2018 14:35	1
HS18080501-04	17SS77-0.0-0.5	08 Aug 2018 13:50		10 Aug 2018 09:51	16 Aug 2018 14:37	1
HS18080501-05	17SS78-0.0-0.5	08 Aug 2018 14:00		10 Aug 2018 09:51	16 Aug 2018 14:39	1
Batch ID R321965	**Test Name :** MOISTURE - ASTM D2216				**Matrix:** Solid	
HS18080501-01	17SS75-0.0-0.5	08 Aug 2018 13:30			17 Aug 2018 12:40	1
HS18080501-02	17SS75-0.0-0.5-FD	08 Aug 2018 13:30			17 Aug 2018 12:40	1
HS18080501-03	17SS76-0.0-0.5	08 Aug 2018 13:40			17 Aug 2018 12:40	1
HS18080501-04	17SS77-0.0-0.5	08 Aug 2018 13:50			17 Aug 2018 12:40	1
HS18080501-05	17SS78-0.0-0.5	08 Aug 2018 14:00			17 Aug 2018 12:40	1

ALS Group Houston, Corp Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant
WorkOrder: HS18080501

QC BATCH REPORT

Batch ID: 131368 **Instrument: ICPMS04** **Method: SW6020**

MBLK Sample ID: **MBLK-131368** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:25**
Client ID: Run ID: **ICPMS04_321797** SeqNo: **4695286** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	0.059	0.500								J

LCS Sample ID: **LCS-131368** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:28**
Client ID: Run ID: **ICPMS04_321797** SeqNo: **4695287** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	9.99	0.500	10	0	99.9	80 - 120				

MS Sample ID: **HS18080501-05MS** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:48**
Client ID: **17SS78-0.0-0.5** Run ID: **ICPMS04_321797** SeqNo: **4695296** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	88.29	0.469	9.381	66.31	234	75 - 125				SO

MSD Sample ID: **HS18080501-05MSD** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:50**
Client ID: **17SS78-0.0-0.5** Run ID: **ICPMS04_321797** SeqNo: **4695297** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	86.5	0.466	9.314	66.31	217	75 - 125	88.29	2.04	20	SO

PDS Sample ID: **HS18080501-05PDS** Units: **mg/Kg** Analysis Date: **16-Aug-2018 14:53**
Client ID: **17SS78-0.0-0.5** Run ID: **ICPMS04_321797** SeqNo: **4695298** PrepDate: **10-Aug-2018** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	74.61	0.469	9.377	66.31	88.6	75 - 125				O

SD Sample ID: **HS18080501-05SD** Units: **mg/Kg** Analysis Date: **16-Aug-2018 15:44**
Client ID: **17SS78-0.0-0.5** Run ID: **ICPMS04_321797** SeqNo: **4695307** PrepDate: **10-Aug-2018** DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Barium	66.37	2.34					66.31	0.0901	10	

The following samples were analyzed in this batch: HS18080501-01 HS18080501-02 HS18080501-03 HS18080501-04 HS18080501-05

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant
WorkOrder: HS18080501

QC BATCH REPORT

Batch ID: R321965 **Instrument: Balance1** **Method: ASTM D2216**

DUP Sample ID: **HS18080705-08DUP** Units: **wt%** Analysis Date: **17-Aug-2018 12:40**
Client ID: Run ID: **Balance1_321965** SeqNo: **4698026** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Percent Moisture	18.4	0.0100					17.6	4.44	20	

The following samples were analyzed in this batch: HS18080501-01 HS18080501-02 HS18080501-03 HS18080501-04 HS18080501-05

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group Houston, Corp Date: 20-Aug-18

Client: Aptim Environmental & Infrastucture, Inc.
Project: Longhorn Army Ammunition Plant
WorkOrder: **HS18080501**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL/SDL

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitaion Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

ALS Group Houston, Corp Date: 20-Aug-18

CERTIFICATIONS,ACCREDITATIONS & LICENSES

Agency	Number	Expire Date
Oklahoma	2017-088	31-Aug-2018
North Carolina	624-2018	31-Dec-2018
Arkansas	88-0356	27-Mar-2019
Texas	T10470231-18-21	30-Apr-2019
North Dakota	R193 2018-2019	30-Apr-2019
Illinois	004438	29-Jun-2019
Louisiana	03087	30-Jun-2019
Dept of Defense	L2231 Rev 3-30-2018	22-Dec-2018
Kentucky	123043 - 2018	30-Apr-2019
Kansas	E-10352 2018-2019	31-Jul-2019
Oklahoma	2018-156	31-Aug-2019

00915954

Date: 20-Aug-18

Sample Receipt Checklist

Client Name: CBI-Houston
Work Order: HS18080501

Date/Time Received: **09-Aug-2018 08:40**
Received by: **JRM**

Checklist completed by: *Pablo Marinez* eSignature — 9-Aug-2018 Date

Reviewed by: *RJ Modashia* eSignature — 10-Aug-2018 Date

Matrices: **SOLID**

Carrier name: **FedEx Priority Overnight**

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
TX1005 solids received in hermetically sealed vials?	Yes ☐	No ☐	N/A ☑
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Temperature(s)/Thermometer(s):	3.0C/2.6C UC/C	IR # 11	
Cooler(s)/Kit(s):	2738		
Date/Time sample(s) sent to storage:	8/9/2018 18:30		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑
pH adjusted?	Yes ☐	No ☐	N/A ☑
pH adjusted by:			

Login Notes:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

APTIM

Page 1 of 1

COC ID: 08-AUG2018-SO-ALSHT-080818 TURNAROUND TIME: normal RUSH:

PROJECT/CLIENT INFO		LABORATORY		OTHER INFO	
Facility Name	Longhorn AAP	Lab Name	ALS Laboratories	Email Invoice To	FedInvoices@CBIFederalServices.com
Project Number	501032	Lab Contact	Sonia West		
	LHAAP-17	Email	Sonia.West@alsglobal.com	Email Report To	Sharon.Pennington@CBIFederalServices.com
Address	1303-B East Grand Avenue	Address	10450 Stancliff Rd, Suite 210	Mail Reports To	Sharon Pennington
	PMB 202			Address	2410 Cherahala Blvd.
City	Marshall State TX	City	Houston State TX	City	Knoxville State TN
Postal Code	75670 Country USA	Postal Code	77099 Country USA	Postal Code	37932 Country USA
Phone Number	713.243.7264	Phone Number	281.575.2132 or 281.530.5656		
Project Manager	Praveen Srivastav			Shipping Company	FedEx 737697522677

SAMPLE DETAILS / ANALYSIS REQUESTED

Sample ID	Location	Start Depth	End Depth	Depth Unit	Field Matrix	Date	Time (24hr)	# Of Cont.	Barium in Soil by Method 6020A
17SS75-0.0-0.5	LHAAP-17	0	0.5	FT	SO	8/8/2018	1330	1	X
17SS75-0.0-0.5-FD	LHAAP-17	0	0.5	FT	SO	8/8/2018	1330	1	X
17SS76-0.0-0.5	LHAAP-17	0	0.5	FT	SO	8/8/2018	1340	1	X
17SS77-0.0-0.5	LHAAP-17	0	0.5	FT	SO	8/8/2018	1350	1	X
17SS78-0.0-0.5	LHAAP-17	0	0.5	FT	SO	8/8/2018	1400	1	X

HS18080501
Aptim Environmental & Infrastucture, Inc.
Longhorn Army Ammunition Plant

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
	David Rowan / APTIM (signature)	8/8/2018 1530	J. [illegible]	8/9/18 09:40

WC
Cooler # 9776 ... 3.0 ...

ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887

2738

CUSTODY SEAL
Date: 8/9/18 Time: 15:40
Name:
Company: ALS

Seal Broken By:
Date: 08/09/18

2738 AUG 0 9 2018

ALS
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887

2738

CUSTODY SEAL
Date: 8/9/18 Time: 1540
Name:
Company: ALS

Seal Broken By:
Date: 08/09/18

TO CLIENT SERVICES
ALS LABORATORY GROUP
10450 STANCLIFF ROAD
SUITE 210
HOUSTON TX 77099

2738

(281) 530-5656
REF: LHAA > 37 - RJ
RMA:

FedEx Express

FedEx
TRK# 0221 7376 9752 2677

THU - 09 AUG 10:30A
PRIORITY OVERNIGHT

AB SGRA

77099
TX-US IAH

ALS
10450 Stancliff
Houston, TX, Suite 210
Tel. +1 281 5656
Fax. +1 281 588

2738

CUSTODY SEAL
Date: 8/9/18 Time: 1540
Name:
Company: ALS

Seal Broken By:
Date: 08/09/18

Appendix B

Sample Collection Logs for August 2018 Soil Samples

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS67**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS67-0.0-0.5

DATE/TIME: 8/9/2018 / 09:45

Sample Interval: 0 - 0.5 Ft

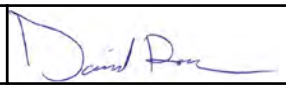
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	METALS	SW6020A

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS68**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS68-0.0-0.5

DATE/TIME: 8/9/2018 / 09:55

Sample Interval: 0 - 0.5 Ft

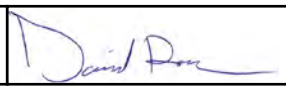
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	METALS	SW6020A

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS69**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS69-0.0-0.5

DATE/TIME: 8/9/2018 / 10:05

Sample Interval: 0 - 0.5 Ft

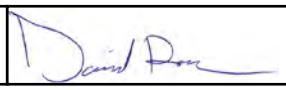
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	METALS	SW6020A

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS70**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS70-0.0-0.5

DATE/TIME: 8/9/2018 / 10:15

Sample Interval: 0 - 0.5 Ft

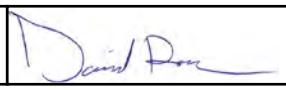
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	METALS	SW6020A

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS71**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS71-0.0-2.0

DATE/TIME: 8/9/2018 / 00:00

Sample Interval: 0 - 2 Ft

Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	EXPLOSIVES	SW8330

Sampler:	David Rowan	David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS71**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS71-5.0-7.0

DATE/TIME: 8/9/2018 / 13:20

Sample Interval: 5 - 7 Ft

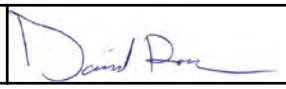
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes: No Recovery. Too wet to sample with hand auger, below water table

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	EXPLOSIVES	SW8330

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS72**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS72-0.0-2.0

DATE/TIME: 8/9/2018 / 11:20

Sample Interval: 0 - 2 Ft

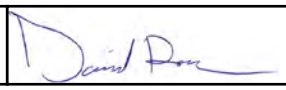
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	EXPLOSIVES	SW8330

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS72**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS72-5.0-7.0

DATE/TIME: 8/9/2018 / 00:00

Sample Interval: 5 - 7 Ft

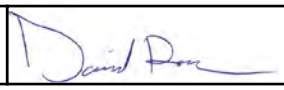
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes: No Recovery. Hit refusal at 2.5-3'. Retrieved bits of metal, caliche and glass. Assumed to be blocking advancement. Tried multiple locations around orginal point. Same result.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS72**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS72-7.0-9.0

DATE/TIME: 8/9/2018 / 00:00

Sample Interval: 7 - 9 Ft

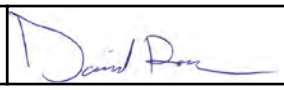
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes: No Recovery. Hit refusal at 2.5-3'. Retrieved bits of metal, caliche and glass. Assumed to be blocking advancement. Tried multiple locations around orginal point. Same result.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS73**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS73-0.0-2.0

DATE/TIME: 8/9/2018 / 11:30

Sample Interval: 0 - 2 Ft

Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	EXPLOSIVES	SW8330

Sampler:	David Rowan	David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS73**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS73-5.0-7.0

DATE/TIME: 8/9/2018 / 00:00

Sample Interval: 5 - 7 Ft

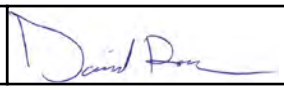
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes: No Recovery. Hit refusal at 2.5-3'.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS73**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS73-7.0-9.0

DATE/TIME: 8/9/2018 / 00:00

Sample Interval: 5 - 7 Ft

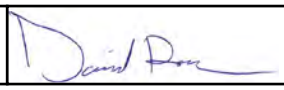
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes: No Recovery. Hit refusal at 2.5-3'.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS74**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS74-0.0-2.0

DATE/TIME: 8/9/2018 / 11:40

Sample Interval: 0 - 2 Ft

Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	EXPLOSIVES	SW8330

Sampler:	David Rowan	David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS74**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS74-5.0-7.0

DATE/TIME: 8/9/2018 / 13:30

Sample Interval: 5 - 7 Ft

Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes: 17SS74-5.0-7.0MS/MSD

Chain of Custody	COC Notes	Analysis Group	Analytic Method
09-AUG2018-SO-ALSHT-080918	None	EXPLOSIVES	SW8330

Sampler:	David Rowan	David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS74**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS74-7.0-9.0

DATE/TIME: 8/9/2018 / 00:00

Sample Interval: 7 - 9 Ft

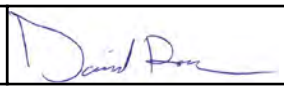
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes: No Recovery. Too wet to sample with hand auger, below water table

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS75**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS75-0.0-0.5

DATE/TIME: 8/8/2018 / 13:30

Sample Interval: 0 - 0.5 Ft

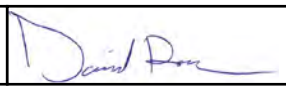
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes: 17SS75-0.0-0.5-FD

Chain of Custody	COC Notes	Analysis Group	Analytic Method
08-AUG2018-SO-ALSHT-080818	None	METALS	SW6020A

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **17SS75**

Project No: **501032**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS75-0.0-0.5-FD

DATE/TIME: 8/8/2018 / 13:30

Sample Interval: 0 - 0.5 Ft

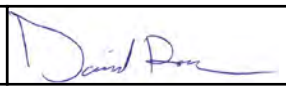
Sampling Method: HA

Sample Purpose: FD

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
08-AUG2018-SO-ALSHT-080818	None	METALS	SW6020A

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS76**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS76-0.0-0.5

DATE/TIME: 8/8/2018 / 13:40

Sample Interval: 0 - 0.5 Ft

Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
08-AUG2018-SO-ALSHT-080818	None	METALS	SW6020A

Sampler:	David Rowan	David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS77**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS77-0.0-0.5

DATE/TIME: 8/8/2018 / 13:50

Sample Interval: 0 - 0.5 Ft

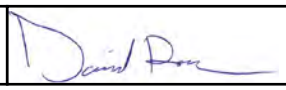
Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
08-AUG2018-SO-ALSHT-080818	None	METALS	SW6020A

Sampler:		David Rowan	
QC'ed By:		William Foss	11/12/2018

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **17SS78**

Sampler(s): **David Rowan**

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 17SS78-0.0-0.5

DATE/TIME: 8/8/2018 / 16:20

Sample Interval: 0 - 0.5 Ft

Sampling Method: HA

Sample Purpose: REG

Sample Matrix: SO

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
08-AUG2018-SO-ALSHT-080818	None	METALS	SW6020A

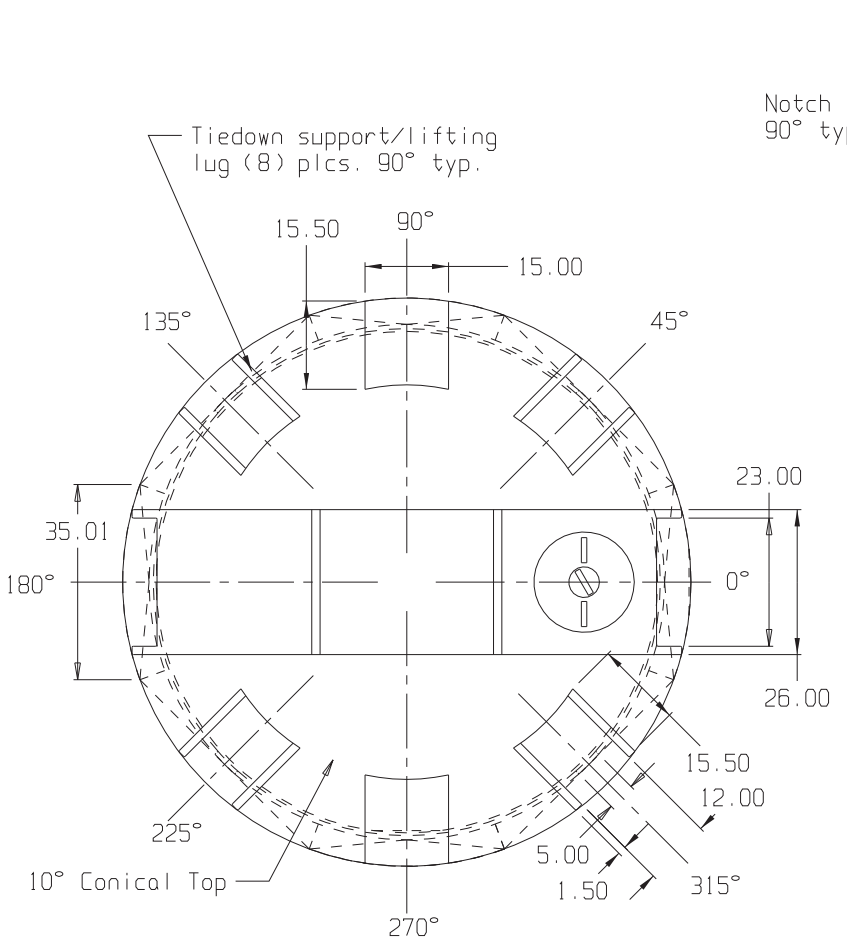
Sampler:	David Rowan	David Rowan	
QC'ed By:		William Foss	11/12/2018

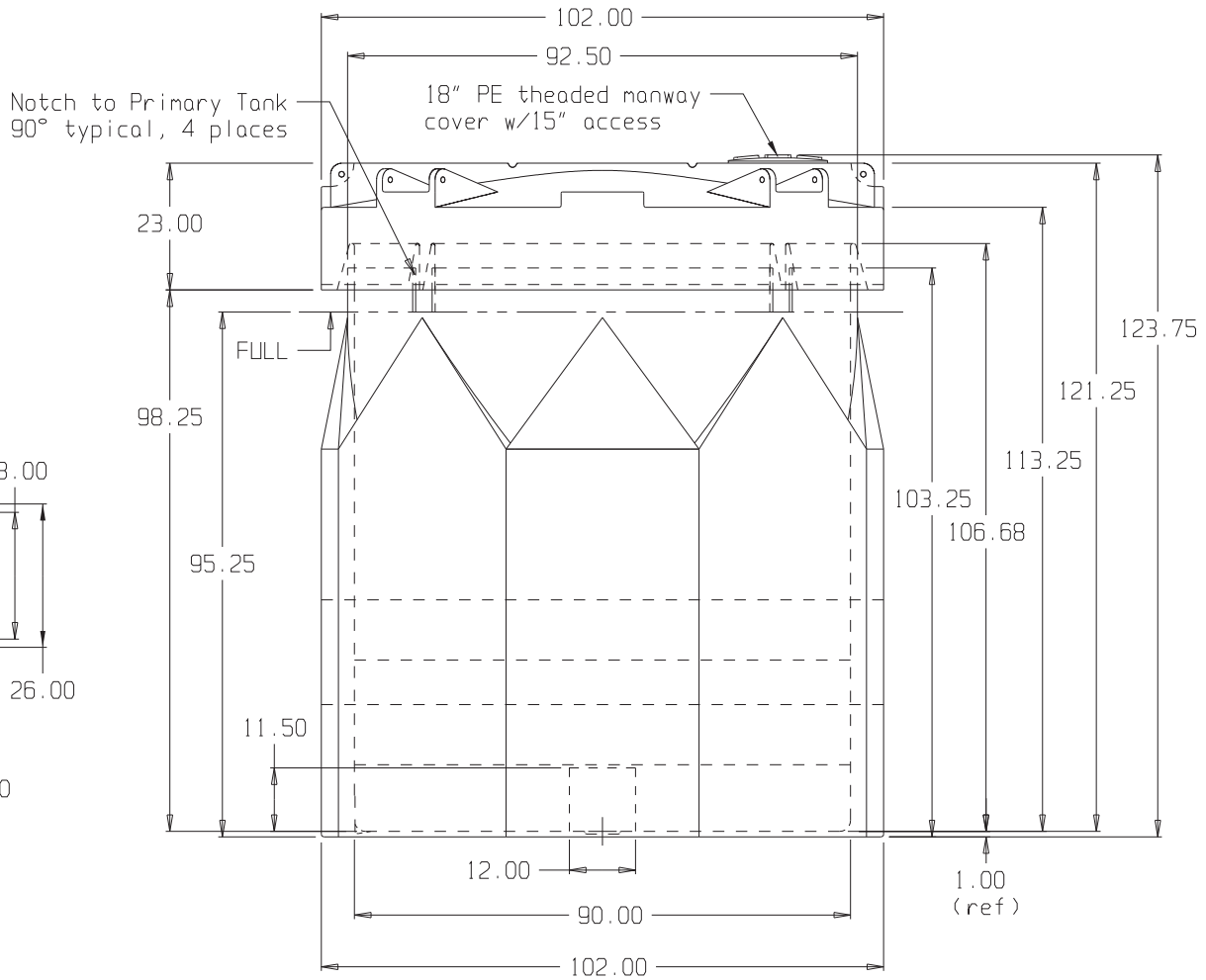
Appendix C

Groundwater Extraction Pump and Holding Tank Specification Sheets

00915979

SNYDER INDUSTRIES INC.





(all dimensions in inches)

BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER Sii PROCEDURE

2,500 GALLON CAPTOR CONTAINMENT SYSTEM

PART #	PRIMARY:	5580--
	CONTAINMENT:	5510--
REF#:	0000	07/29/02

Secondary Containment => Double Wall Plastic Tanks

Underground Water Storage Tanks (Cisterns)
Underground Water Tanks
RV Water & Waste Holding Tanks
RV Fresh Water Tanks
RV Holding Tanks
Marine Water & Waste Holding Tanks for Boats
Marine Water Storage Tanks for Boats
Marine Holding Tanks
Marine Fuel Tanks
Water & Liquid Storage Tanks
Plastic Water Tanks
Plastic Storage Tanks
Cone Bottom Tanks
Horizontal Hauling & Storage Tanks
Water Pumps
Low Profile Hauling & Storage Tanks
Flat Bottom Portable Water Tanks
Truck Bed Water Tanks Specials
Rectangular Water & Waste Tanks
Double Wall Tanks
Plastic Stock Tanks - Water Troughs
Elliptical Cradle Tanks
Auto Detailing Tanks
Doorway Water Tanks (29")
PCO Liquid Transport Tanks
Stackable Water Tanks
Brine Storage Tanks
Forkliftable Water Tanks
Stackable Oil Storage Totes
Fuel Tanks
Plastic Open Top Tanks
Open Top Cylindrical Tanks
Open Top Rectangular Tanks
Open Top Cone Bottom Tanks
Plastic Septic Tanks for Sale
Plastic Septic Tanks
Norwesco Bruiser Tanks
Job Shack Holding Tanks
Secondary Containment
Spill Containment Trays
Secondary Containment Basins
Bulkhead Fittings - Lids - Gaskets
Ball Valves
Bulkhead Fittings
Strainer Baskets
Lids
Inspection Lids
Gaskets
Water Tank Float Valves
Siphon Tubes
Baffle Balls - Surgebusters
Pipe Plugs
Heat Blankets
Polypropylene Tanks

2500 Gallon Double Wall Tank

Wrap Option: Select a Wrap Option

Price: $6,899.99 Add to Cart

$190 / month

Part Number:	SII-CCS2500
Mfr. Part Number:	5580000N-45
Capacity:	2500 Gallons
Dimensions:	102" dia. x 123-3/4"H
Weight:	1420 lbs.
Ships From:	NE, WV
USD Shipping:	Call For Shipping Rate 866 310 2556 or Email
PDF Drawing:	View Technical Drawing
Manufacturer:	Snyder Industries
Material:	Polyethylene
Availability:	In Stock *(Stock changes daily please call to confirm)*

Contact Us

Shown With Accessories : Sold Separately

2500 Gallon Captor Double Wall Liquid Storage Tank - 1.9 Specific Gravity

2500 Gallon Snyder Industries Captor Double Wall Liquid Storage Tank Includes:

- 18" Threaded Manway Comes Standard (Bolted and Threaded Manways are available in sizes up to 24" by request.)
- Molded In Tie-Down Lugs (interface with optional cable restraint system to meet seismic and 150 mph wind load requirements.)
- Provides 115%-120% containment of inner tank's capacity.
- Resin complies with U.S. Food and Drug Administration regulation 21 CFR 177.1570 (c) 3.1 and 3.2.
- Through tank fittings available by request.
- Outer containment of the double wall tank complies with federal regulation 40CFR-264.193 capacity requirements.

This tank is made from High Density Linear Polyethylene. It is also made in crosslinked linear polyethylene by request.

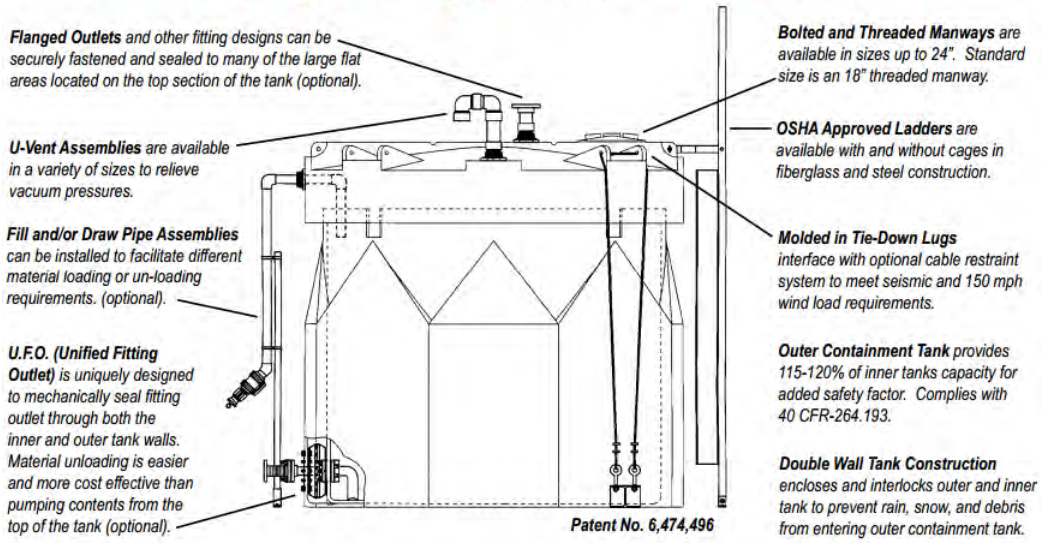
Optional Fittings Include:

- Flanged Outlets (Can be securely fastened and sealed to many of the large flat areas located on the top section of the tank.
- Fill and/or Draw Pipe Assemblies (can be installed to facilitate different material loading or un-loading requirements.)
- U Vent Assemblies (available in a variety of sizes to relieve vacuum pressures.)
- U.F.O. (Unified Fitting Outlet)(uniquely designed to mechanically seal fitting outlet through both the inner and outer tank walls. Material unloading is easier and more cost effective than pumping contents from the top of the tank.)
- OSHA Approved ladders are available with and without cages in fiberglass and steel construction.
- Double Wall Tank Construction encloses and interlocks outer and inner tank to prevent rain, snow, and debris from entering outer containment tank.

Captor Double Wall liquid storage tanks can not be pressurized. This double wall liquid storage tank can hold liquids with a material weight up to 15.83 lbs. per gallon (1.9 specific gravity rating). (Water weighs 8.34 pounds)

Captor Containment System

Protects Bulk Storage Profits
Without Jeopardizing Safety or the Environment



Simplex Part Number: CCS2500-1.9

AP4+B

Bottom Inlet, Short

Max. Flow	**13 gpm (49 lpm)**
O.D.	**3.6 in. (9.1 cm)**
Length	**39.3 in. (100 cm)**

Description

The AP4+ Bottom Inlet Short AutoPump provides maximum capabilities and flow in a bottom inlet pump for 4" (100 mm) diameter and larger wells with shorter water columns and/or the need to pump down to lower water levels, compared to full-length pumps. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 13 gpm (49 lpm)*. The AP4+ Short Bottom Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site-specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

The AutoPump Heritage

The AP4+ Bottom Inlet Short AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as hydrocarbons, solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, wellhead caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

Advantages

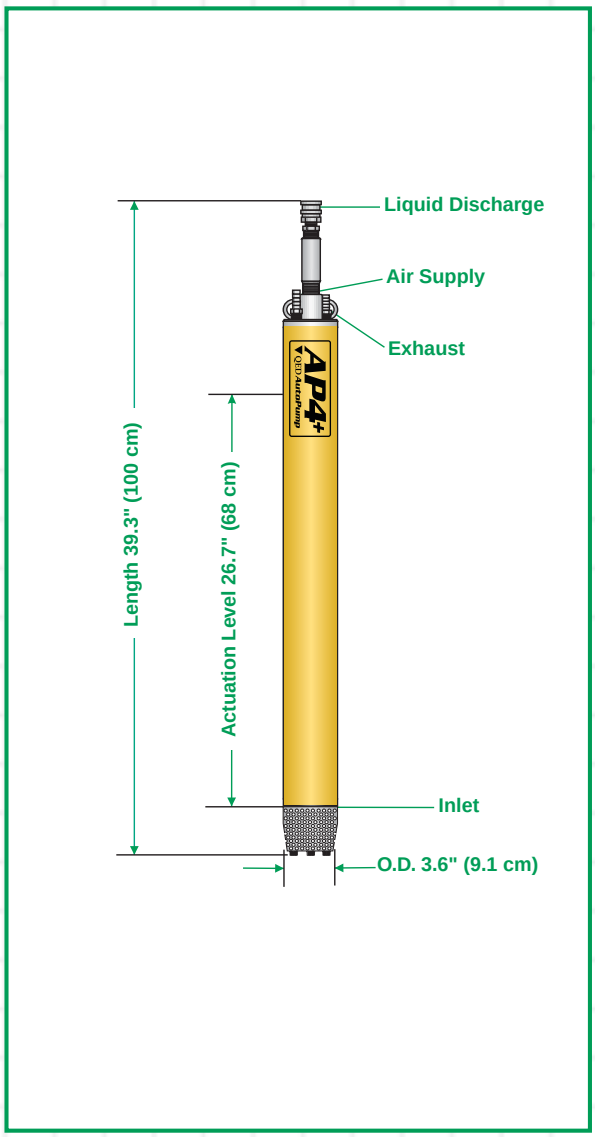
1. **The original automatic air-powered well pump, proven worldwide over 25 years**
2. **The highest flow rates and deepest pumping capabilities in the industry**
3. **Patented, proven design for superior reliability and durability, even in severe applications**
4. **Handles solids, solvents, hydrocarbons corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps**
5. **Five-year warranty**

***Consult QED for higher flow requirements**

00915983

Bottom Inlet, Short AP4+B

Pump Dimensions



Specifications & Operating Requirements

Model	**4" - Short AP4+ Bottom Inlet**
Liquid Inlet Location	Bottom
OD	3.6 in. (9.1 cm)
Length Overall (pump & fittings)	39.3 in. (100 cm)
Weight	13 lbs. (5.9 kg)
Max. Flow Rate	13 gpm (49 lpm)* - See Flow Rate Chart
Pump Volume / Cycle	0.22 - 0.36 gal (.83 - 1.36L)
Min. Actuation Level	26.7 in. (68 cm)
Standard Pump	
Max. Depth	250 ft. (76 m)
Air Pressure Range	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	0.4-1.5 scf / gal. (1.5 - 5.7 liters of air / fluid liter) - See Air Usage Chart
High Pressure Pump	
Max. Depth	425 ft. (130 m)
Air Pressure Range	5 - 200 psi (0.4 - 14.1 kg/cm2)
Min. Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials[1]	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF[3]
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs or Quick Connects
Tube & Hose Options	
Tubing Material[2]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Material upgrades available
[2] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.
[3] PVDF - Polyvinylidene Fluoride

Application Limits (Base model)

AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4 upgrades.

Maximum Temperature: 150°F (65°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6, #2 heating oils, BTEX, MTBE, landfill liquids

***Consult QED for higher flow requirements**

Long and Short AP4+ AutoPumps are warranted for five (5) years: 100% materials and workmanship.

Low-Drawdown AutoPumps are warranted for one (1) year: 100% materials and workmanship.

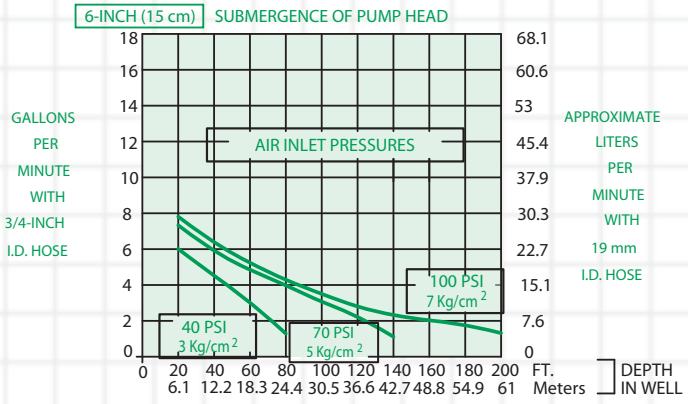
2355 Bishop Circle West Dexter, MI 48130 USA **1.800.624.2026** **F 1.734.995.1170** info@qedenv.com www.qedenv.com

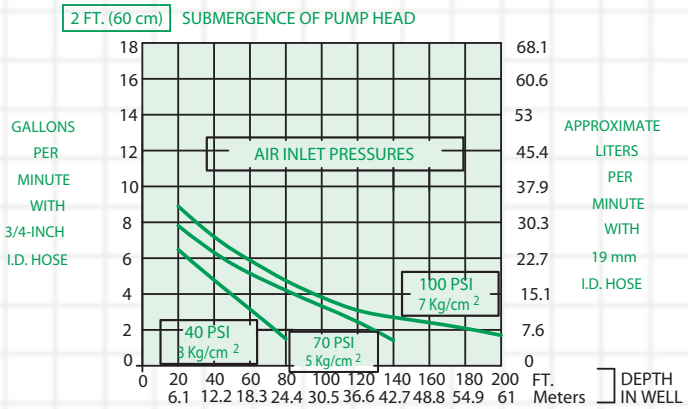
AP4+B

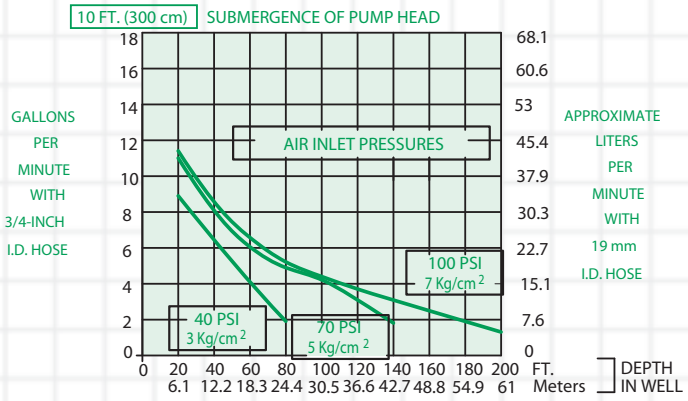
Bottom Inlet, Short

Flow Rates[1]

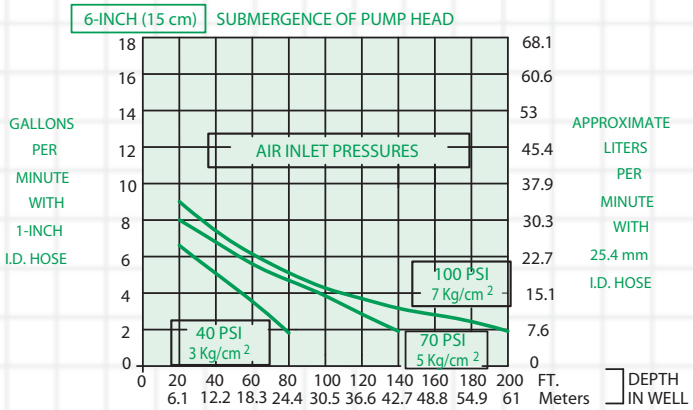
3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)

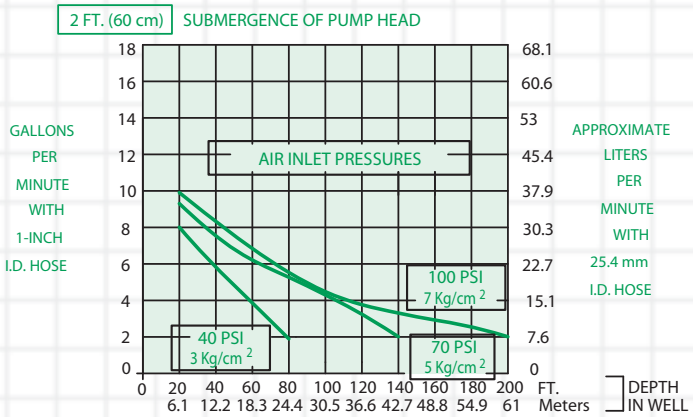


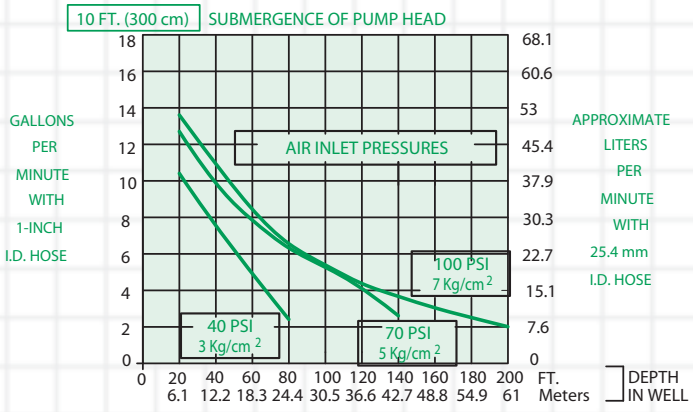




1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivilant to 1.25-Inch O.D. Tubing)







[1]FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

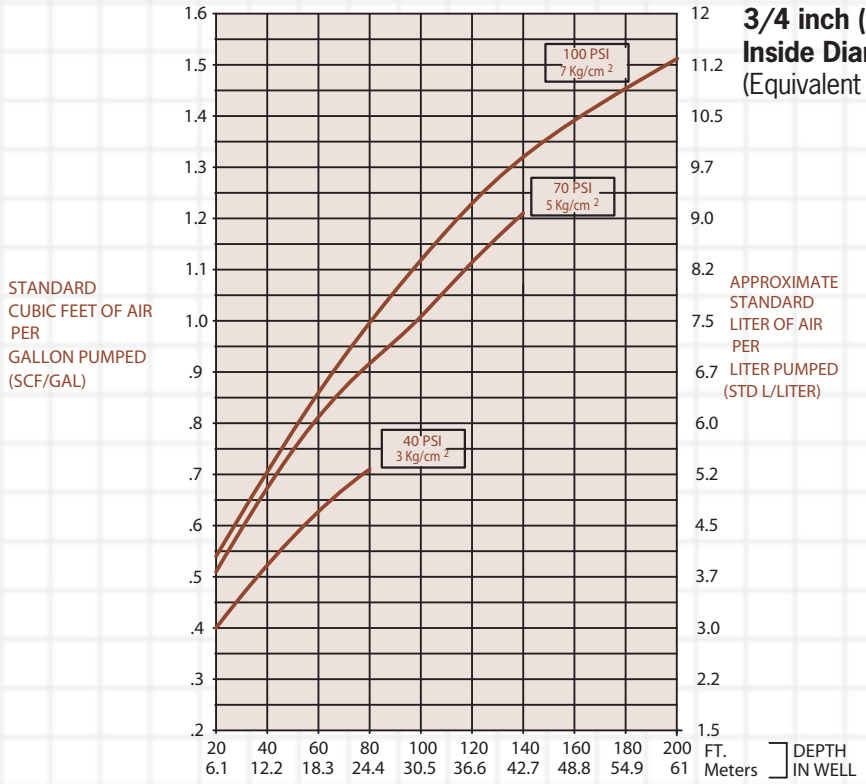
00915985

Bottom Inlet, Short

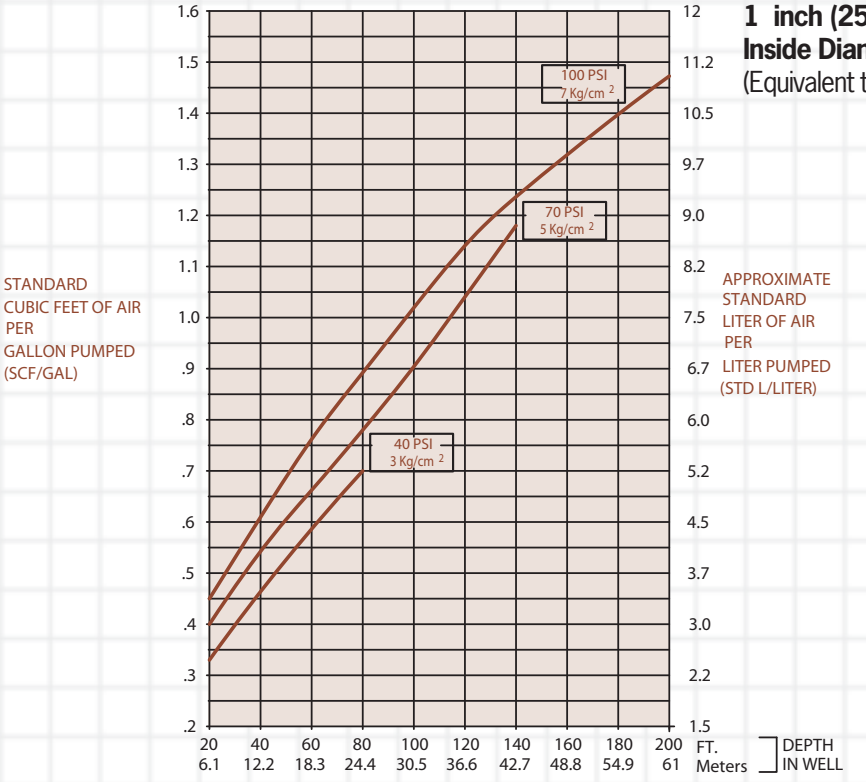
AP4+B

Air Consumption

3/4 inch (19 mm)
Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm)
Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)



2355 Bishop Circle West Dexter, MI 48130 USA **1.800.624.2026** **F 1.734.995.1170** info@qedenv.com www.qedenv.com

Appendix D

Operation and Maintenance Forms

RAO Inspection and Maintenance Checklist

General Information	
Project Name	RAO Inspection and Maintenance, LHAAP-17, Longhorn Army Ammunition Plant, Karnack, TX
Contractor	
Inspector's Name	
Inspector's Title	
Inspector's Signature	
Inspector's Contact Number	
Inspection Date	
Type of Inspection	☐ Quarterly ☐ Semiannual ☐ Annual ☐ Prior to forecast rain ☐ After a rain event ☐ Other ----------

A. Groundwater Monitoring Wells						
D.1	Are the installed groundwater monitoring wells in poor condition?					
D.2	Is the well cleared of vegetation and accessible?					
D.3	Any other relevant observations?					
D.4	Are there any significant cracks present?					
D.5	Are there any damaged areas?					

LHAAP-17
Weekly Extraction System Tracking and Maintenance Form

Date	Time	Inspector	17WW02 Volume (gallons)	17WW06 Volume (gallons)	Compressor Pressure (PSI)	Well Head Check	Tanks and Transfer Pump	Tank/Compressor/Pump Notes and Maintenance Performed
						Secure Y/N Leaks Y/N	Secure Y/N Leaks Y/N	
						Secure Y/N Leaks Y/N	Secure Y/N Leaks Y/N	
						Secure Y/N Leaks Y/N	Secure Y/N Leaks Y/N	
						Secure Y/N Leaks Y/N	Secure Y/N Leaks Y/N	
						Secure Y/N Leaks Y/N	Secure Y/N Leaks Y/N	
						Secure Y/N Leaks Y/N	Secure Y/N Leaks Y/N	
						Secure Y/N Leaks Y/N	Secure Y/N Leaks Y/N	
						Secure Y/N Leaks Y/N	Secure Y/N Leaks Y/N	

Appendix E

LUC Compliance Certification

Annual Land Use Control Compliance Certification Form

In accordance with the Remedial Design dated _____ for LHAAP-17 an inspection of the site was conducted by _____ [indicate transferee] on _____.

The land use control mechanisms are:

- Groundwater restrictions - prohibit access to the contaminated groundwater except for environmental monitoring and testing only until cleanup goals are met;
- Land use restrictions - restrict land use to nonresidential;
- Integrity of remedial and monitoring systems - maintain the integrity of any current or future remedial or monitoring systems until cleanup goals are met.

No unauthorized activities or uses have occurred. Compliance with land use controls and restrictions is as follows:

- No use of groundwater (other than environmental testing and monitoring), installation of new groundwater wells, or tampering with existing monitoring wells;
- No land use other than nonresidential; and
- No activities that would compromise the integrity of the remedial or monitoring systems.

I, the undersigned, do document that the inspection was conducted as indicated above, and that the above information is true and correct to the best of my knowledge, information, and belief.

Date: _____

Name/Title: _____

Signature: _____

Annual compliance certification forms shall be completed no later than March 1 of each year for the previous calendar year, retained in the file and provided to Army, EPA and TCEQ upon request.

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

March 18, 2019

DAIM-ODB-LO

Mr. Rich Mayer
U.S. Environmental Protection Agency
Federal Facilities Section R6
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Draft Final Post Screening Investigation Report, LHAAP-47, Longhorn Army Ammunition Plant, Karnack, Texas, March 2019

Dear Mr. Mayer,

Two hard copies (HC) and two compact discs (CDs) of the above-referenced document are being transmitted to you for your records. The document includes revisions based upon the Environmental Protection Agency's (EPA) comments on the Draft received on February 21, 2019. In accordance with the Federal Facility Agreement, this Draft Final will be considered Final after 30 days without further comment. Response to comments on the Draft version of the document are included within this Draft Final.

The document was revised by HDR Environmental, Operations and Construction, Inc. (HDR) on behalf of the Army as part of HDRs contract for the facility. I ask that Phil Werner, HDR's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX (1 hard copy, 1 CD)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy, 1 CD)
A. Williams, USACE, Tulsa District, OK (1 CD)
R. Smith, USACE, Tulsa District, OK
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate – Lakewood, CO (for project files)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

March 18, 2019

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality
Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Draft Final Post Screening Investigation Report, LHAAP-47, Longhorn Army Ammunition Plant, Karnack, Texas, March 2019

Dear Ms. Palmie,

One hard copy (HC) and one compact disc (CD) of the above-referenced document are being transmitted to you for your records. The document includes revisions based upon the Texas Commission on Environmental Quality's (TCEQ) comments on the Draft received on February 20, 2019. In accordance with the Federal Facility Agreement, this Draft Final will be considered Final after 30 days without further comment. Response to comments on the Draft version of the document are included within this Draft Final.

The document was revised by HDR Environmental, Operations and Construction, Inc. (HDR) on behalf of the Army as part of HDRs contract for the facility. I ask that Phil Werner, HDR's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
R. Mayer, USEPA Region 6, Dallas, TX (2 hard copies, 2 CDs)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy, 1 CD)
A. Williams, USACE, Tulsa District, OK (1 CD)
R. Smith, USACE, Tulsa District, OK
A. Maly, USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate – Lakewood, CO (for project files)

Comments on:

Draft PSI Report for LHAAP-47, Plant 3 Area, Solid Rocket Motor Fuel Production, Longhorn Army Ammunition Plant, Karnack, Harrison County, Texas Submitted: 25 January 2019

Submitted by: USACE / HDR
Responded by: April Palmie, TCEQ Project Manager / Rich Mayer, USEPA Project Manager
Date Responded: February 19, 2019 / February 20, 2019

1. **Respondent concurs (C) or does not concur (D), or there is an exception.**
2. **Commenter agrees (A) or does not agree (D) with response.**

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
Reviewer #1: April Palmie, TCEQ						
1	2.5, 2-5	2nd	2nd paragraph, last sentence should say "HSA" not "HSS"	C	The correction has been made.	
2	2.11, 2-11	1st	1st paragraph, last sentence is not clear. There are more than eight dry wells. Include the wells not measured because they were dry in Phase I and add to the list a total number of dry wells not measured in Phase II.	C	The text was updated to reflect nine dry wells during development, rather than five, which is also reflected in Table 3. Additionally, a reference to Figure 3 and Section 2.2 was added: "Three wells were recorded as dry during the water level sweep, while nine additional wells were recorded as dry during development activities. Wells listed in **Section 2.2** were also noted as dry, many of which were replaced with deeper monitoring wells. **Figure 3** displays the wells that were noted as dry."	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
3	General, Section 3 and Figures		The shallow/intermediate and intermediate results should be discussed and mapped separately. Separate discussion and mapping will help for the ROD and as we look at where to target treatment. Suggest using the term Upper Intermediate or Shallow Intermediate (not Shallow/Intermediate). If term is revised, update usage throughout the document, including figures and tables.	C/E	Concur that the replacement wells should be identified as representative of the upper intermediate zone aquifer, but do not concur that they should be presented separately in the text, tables and figures. The text will be revised to state that an "R" appended to a well name designates it as a replacement for a dry shallow zone well. The replacement wells were drilled to 40 feet and extended into the intermediate zone sand. The wells were completed in the intermediate sand but also included some clay separating the shallow and intermediate zones.	
4	3.1, 3-1	4th	4th paragraph – These findings should be documented on the cross sections.	C	Newly installed wells were added to the Appendix H cross sections.	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
5	4, 4-1	3rd	3rd paragraph in "Extent" section a. Revise 2nd sentence. Additional wells were installed to have a better understanding for remedy implementation. The point was not to have more points for the contaminant plume figures. Suggestion follows (revise at will): These replacement wells into the Upper Intermediate Zone provide additional information to characterize the groundwater impacts underlying the clay layer between the Shallow and Intermediate Zones (as depicted in Figure #). b. The conclusion in the last sentence is too simplistic. The shallow well data by 42-H (47DPT15) had 1580 µg/L and at LHAAP the clay can source perchlorate to the underlying groundwater. Try to add this information to the discussion(s) where relevant.	a. C/E b. C	a. The sentence was replaced with following edit: "These replacement wells into the upper Intermediate Zone provide updated information on groundwater impacts underlying the clay layer between the Shallow and Intermediate Zones (as depicted in **Appendix H** cross-sections)." b. The nearest well to 47DPT15 is 47WW11R. There is no groundwater left at this location, as 47WW11 is now dry and has been replaced with the deeper 47WW11R. The intermediate contour map shows that a perchlorate plume is present at this location, and this presence is described in detail in paragraph 4 of the "Comparison with Previous Data, Intermediate Zone" section. Your point is understood that the clay still likely contains perchlorate, even in the absence of groundwater, but since this effort focuses on groundwater only and soil would need to be considered/addressed as part of the remedial design, the sentence was simply revised to read: "Due to the lack of groundwater in the Shallow Zone, perchlorate *groundwater* contamination is not present."	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
6	Soil borings		Add a table and figure(s) to include the soil boring sample results.	D	To be clear, only groundwater grab samples were collected from the soil borings. There is no soil data for the PSI effort. Table 2 (now updated to Table 1) of Attachment 2 includes the groundwater grab results. Figure 5 and Figure 6 in Attachment 1 display the soil boring locations and groundwater grab sample results in map form. It should also be noted that the groundwater grab sample from SB-09 was not intended to be reported in ug/kg units. This only occurred because the water sample was so muddy, the lab ran it as a solid and reported as such. This variance is noted on Figure 6 in the legend.	
7	Attachment 1 Figures		a. Please revise all figures created by HDR. The maps are low resolution (paper and pdf) making them very difficult to read and interpret. Please replace the figures with higher resolution images that take up more of the space on the pages – current figures have about 1.75 inches white space all the way around the maps. Many of the figures in this report should be scaled for 11 X 17 paper. b. The pastel and orange shades for well labels and data are very difficult to read. Please use darker and higher contrast colors. c. Check the map legend for each figure and remove irrelevant symbols and notes. d. Also, revise legend descriptions and notes as needed. For example, Figure 8 includes “not measured” and “with groundwater elevation” – not relevant data for this figure. e. Revise Shallow/Intermediate on all figures to Upper Intermediate or Shallow Intermediate. f. The figures should be searchable in the pdf.	C	a. Figures were revisited to optimize resolution and scale to fit the page. Figures were formatted to 11x17. b. Figures were revisited to select darker and higher contrast labels for the well data. c. Figures were re-checked for irrelevant symbols and notes. d. Legend descriptions and notes were revised as necessary. e. Shallow/Intermediate references were retained for pre-existing wells and revised to “Intermediate (Upper) for new wells. f. The pdf file will be updated to add all figures to the bookmarks.	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
8	Figures 5 & 6		a. The historic data (from FS) should be referenced or included as a separate figure (either in the figures section or in an appendix). The FS related features should be removed from the map legend. The historic contours should not be included with the PSI data. b. The Upper Intermediate (or Shallow Intermediate) and Intermediate results should be mapped separately. c. The PSI data should be mapped separately on soil figure(s) and grab groundwater figure(s). d. When groundwater sample results were reported as soil, revise the pop-out unit of measure accordingly (such as SB-09iA on Figure 6)	a. D b. E/C c. E/C d. E	a. Because the goal of the PSI is to update the groundwater data and to inform the ROD, it is appropriate to present the data upon which the Draft ROD was based, along with the new data to inform it. Changing to an 11 x 17 page size and increasing the resolution of the figures will improve the legibility and utility of the figures. b. Please see the response to Comment No. 3. c. Please see the response to Comment No. 6. d. The SB-09 pop-out was revised to show the results as ug/kg, as opposed to ug/L.	
9	Figures 7 & 8		Please put the groundwater gradient arrow somewhere closer to the plumes and make it blue.	C	The groundwater gradient arrow was moved closer to the plume and re-colored blue.	
10	Figure 8		a. Split data into two figures, one each for Upper Intermediate and Intermediate Zones. b. Instead of putting an * and including just the dup result, please put the sample result/dup result or put dup in ( ) when the results differ.	a. D b. C	a. Please see response to Comment No. 3. b. The parent sample results were added to figure next to the duplicate result. The duplicate result is in parenthesis.	
11	All tables		Revise the dates on all tables.	C	The incorrect date fields were corrected for the tables that had these errors, specifically Tables 2, 3, and 4.	
12	Table 2		2nd page is incorrectly titled Table 3.	C	The table title was corrected.	
13	Table 3		Well depth should be included for dry wells.	C	The depths below ground surface have been added for all wells that were not measured.	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
14	Appendix H		a. Revise the figure called "Proposed Locations" to correct the title, correct the image quality, and fix the road layer projecting over the legend. On this figure, it is not possible to see the new data points as they relate to Shaw's cross sections. Suggest turning off the road layer (for a start). b. The new data points should include more than a red or black box. They should include the screen interval and lithology. c. Cross sections that go through the current groundwater plumes should be created. Most of this information is available on several different cross sections.	a. C b. C c. E	a. This figure was removed and the new wells were added to the cross-section location map. b. The well depictions were updated with screen intervals. c. The creation of completely new cross-sections is beyond the scope of the PSI work plan and this PSI report. Any further work will be addressed in the RD/RA project phase. However, all newly installed replacement wells were added to the Shaw historical cross-sections.	
Reviewer #2: Rich Mayer, USEPA						
1	Page iii	IWWP	Minor typo error, please change "Word" to "Work"	C	Typo was corrected.	
2	Page 1-1, Section 1	3rd paragraph	The first sentence is awkward. Suggest the following revision. "The objective of this PSI is to re-assess and update the groundwater contaminant concentrations for the shallow and intermediate groundwater due to older and limited data."	C	Sentence was replaced with suggested revision.	
3	Page 1-1 Section 1		First use of ROD, please define here.	C	Acronym was defined.	
4	Page 1-1, Sec 1.1	2nd paragraph first sentence	For COCs, it should be contaminants of concern and not chemicals of concern. See page iii of the acronyms.	C	Text was revised to "contaminants" versus "chemicals".	
5	Page 1 -2 Sections 1.2.1 and 1.2.3		In this section and in the next section, the following terms are used: semi-confining, confining, and aquitard. Consistent terms should be used. If the hydraulic heads in the intermediate zone show an upward head, then the use of confining is fine. However, based on most of the information provided, a better term to use would be leaky aquifer or leaky aquitard, since there is vertical movement between the water bearing zones.	C	Sections 1.2.1 and 1.2.3 were edited to refer to "aquitard" for all references. Additionally, a global search was performed for the word "confining" and all references were replaced with aquitard.	
6	Figure 3		Description of the map indicates potentiometric contour, but there are no contours shown. With a large dry zone found, EPA is not sure that this is the best approach to depict flow direction. EPA recommends using a few directional arrows on the map towards the northeast.	C	A note will be added to the legend that due to a majority of shallow wells being dry, contours were not created. Two general groundwater flow direction arrows will be added to the map.	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
7	Page 2-3, Section 2.1	Second to last bullet	Suggest using the term synoptic instead of the term sweep for water level collection event.	C	Synoptic was inserted.	
8	Table 2		The table header has some typos or errors. Is the collection date supposed to be the collection depth? The sample date probably should be included also. The MCLs and TRRP column should have a header. Also, suggest using the reporting level instead of ND, i.e., U or < .10. Is acetone a lab contaminant? Also, information at the bottom of table indicates a * means samples were reported in ug/kg due to high soil content. It appears only one sample was reported this way. EPA assumes the sample must have been close to mud. Also, the table mentions that bold values exceed a standard, but there are no bold numbers in the table even though there are concentrations that do exceed.	C	All errors were corrected as suggested. Acetone was not a lab contaminant, as it was not detected in any method blanks. However, acetone was detected in several trip blanks, and this led to some sample results being qualified as J+.	
9	Section 2		Suggest introducing figures that show locations of SBs, DPTs, and so forth throughout this section such as shown on Figures 5 and 6.	C	References were added as requested.	
10	Page 2-5, Section 2.5		Figures 5 and 6. Just to clarify, the plumes shown here are from 2010, but were the plumes redrawn from previous reports? In Figure 6, the perchlorate plume in the southern area does not seem to make sense based on the data. Well LHSM60 indicates 4.110 (unless it is supposed to be 4,110) for perchlorate and well 50WW06 indicates 113 ug/L for perchlorate. If those numbers are correct, the plume center would be closer to well 50WW06.	C	Yes, these maps were pulled directly from the PSI workplan. The PSI data was simply overlaid on the historical figure so the reader would have the benefit of seeing historical data in relation to the completed PSI borings/wells.	
11	Page 2-5, Section 2.5	2nd paragraph, 2nd sentence	Potential typo. Should HSS be HSA?	C	HSS was corrected to HSA.	
12	Page 2-5	Section 2.5	First use of TCE. Needs to be defined here and added to the acronym list.	C	Document was searched and first use occurs in table at end of Section 1.3. Acronym was defined in this table and follow-on text references were updated to acronym. TCE was added to acronym list.	
13	Page 2-6	3rd paragraph, last 2 sentences	How long was the temporary well left open to allow water from the clay strata to enter the well?	C	Overnight was added to explanation for 47WW26 as follows: “While the second boring produced water overnight (albeit not readily), the boring cores reflected solid clay from the ground surface to 40 feet bgs.”	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
14	Table 3		EPA suggests only reporting elevations and water levels to the hundredths. Why are the well depths not reported in the dry wells? Tagging the bottom of a dry wells does add valuable information (maybe a collapsed well, or how close the well might be to water table based on the surrounding data). Please include the measuring dates for each well.	C	All elevations were changed to hundredths. The measuring date is included in the "Date" column, which will be retitled "Date Measured".	
15	Page 2-11 Section 2.13		TCLP needs to be added to acronym list.	C	TCLP was added to acronym list.	
16	Page 3-1	1st paragraph	Please add Tier 1 residential groundwater acronym to the list.	C	Reference was added to acronym list.	
17	Section 3.1	4th paragraph	EPA agrees with the good description of the issues associated with the perched and various clay layers which makes interpretation of groundwater challenging at Longhorn.	C	Thank you.	
18	Page 3-2	3rd paragraph	EPA suggests adding the concentration of perchlorate to the text for SB-11i even though it is well below the PCL.	C	The concentration was added to the sentence, as follows: "Boring SB-11i had a detection (0.271 µg/L) in the deep sample collected."	
19	Page 3-2	4th paragraph	EPA agrees that acetone is most likely a laboratory contaminant. Laboratory QA/QC should give an indication if it is a lab source and therefore it could be dropped from the discussion.	C	After chemist review, it was determined the acetone detections are not attributed to lab contamination, as it was not detected in any method blanks. However, acetone was detected in several trip blanks, and this led to some sample results being qualified as J+. A discussion of this has been added to the indicated paragraph.	
20	Page 3-2	5th paragraph	EPA suggests providing ranges of contaminant concentrations as found in paragraph 3 to be consistent and provide information to the reader. This should be done throughout this section.	C	Ranges were added as requested.	
21	Table 4		EPA suggests changing the date format as with the other tables. Also, it does not appear that contaminants that exceed any standard are bolded. Please bold those. The regular sample should be included to compare with the DUP-04 (47WW45) sample. Please add J- definition to the bottom of table.	C	Date format was corrected. Values were bolded. 47WW45 parent sample was included in table. J- was added to notes.	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
22	Section 3.3		Based on table 4, there are some potential laboratory issues regarding some bias which appears to be biased high. EPA assumes that there was some blank contamination or some sort of recovery that was outside of the normal. EPA suggests adding a few sentences describing why there are J+ values and so forth.	C	Text was added throughout Section 3.3 to explain biased results, where they occurred.	
23	Section 3.3	Metals	Well 47WW14 slightly exceeded the chromium standard. Does this well have a stainless steel screen? If so the screen might be the potential source of chromium since we have seen this occur at other wells at LHAAP with stainless steel screens.	C	This well does have a stainless steel screen. Text was added to reference this fact, as follows: "47WW14 has a stainless steel screen, which is a potential source of chromium at this location."	
24	Section 3.3	Metals	Under manganese, suggest adding the site background reference to the text.	C	The text has been revised as follows: "Although the manganese TRRP PCL of 1.1 mg/L was exceeded at well 47WW19, the site background for manganese is 7.82 mg/L (Shaw 2007c)." Reference was added to report and previous 2007c reference was removed per comment #35 below.	
25	Section 3.3	VOCs	Acetone is a typical laboratory contaminant. If it is showing up in lab blanks, EPA suggests mentioning that it may be due to lab contamination.	C	Acetone was not a lab contaminant, as it was not detected in any method blanks. However, acetone was detected in several trip blanks, and this led to some sample results being qualified as J+. A discussion of this has been added to the indicated section. Text to this effect was added throughout section.	
26	Section 3.3	VOCs	First use of PCE, should be defined here and added to the acronym list.	C	PCE was defined and added to acronym list.	
27	Section 3.3	Explosives	Please add the explosive acronyms to list.	C	TNT and DNT were added to acronym list.	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
28	Section 3.4	1st paragraph	EPA suggests describing the depth ranges for what is considered the shallow and shallow/intermediate aquifers. Please explain why contouring was not performed?	C	Depth ranges were added to Section 3.1, as follows: "The aquitard is generally encountered approximately 20 feet below ground surface, with the clay being 1-2 feet thick in most locations, then the upper Intermediate to the termination depth of the PSI drilling efforts." Plume boundaries were completed to be consistent with other documents, which was to place a single contour around all exceedances.	
29	Section 3.4	Perchlorate	The text references Figure 7 for perchlorate in the shallow zone, but no perchlorate is found on Figure 7. Please correct.	C	Reference to Figure 7 was removed.	
30	Section 3.4	Perchlorate	Figure 8. EPA is confused on how the plumes were drawn. Since monitoring well 47WW11R had a concentration of 824 ug/L, it seems very close to the 17 ug/L line. One would assume the plume might be a bit larger as you move outward to the bounding wells listed in the text.	C	Plume boundary was moved outward as suggested.	
31	Section 3.4	3rd paragraph	The text indicates that the southern plume is bound to the south by well 50WW27 (maybe 50WW06), but this well is not located on Figure 8. Also, the text mentions soil boreholes with no water also used for bounding but they are not shown on the figure.	C	Well 50WW27 was added to map. Soil boring locations are depicted on Figures 5 and 6, since duplicating this data on the plume maps will make them overly busy. Text was added as follows: "This plume is also bound by Goose Prairie Creek, and separate from the LHAAP-50 plume, as evidenced by 50WW27 data."	
32	Section 3.4	PCE	The values reported for PCE in this text are all perchlorate values and not PCE. Please revise text with proper values.	C	Text was corrected as follows: "PCE was not detected above its MCL in the Shallow Zone and only once in the Intermediate Zone. As shown in Figure 8, the PCE concentration in well 47WW09 exceeded the MCL of 5 µg/L."	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
33	Figure 8		Please add the definitions for J/J+ to inset table. In additional, there are advantages of including a map that includes all the main VOCs, but in this case, would suggest breaking out the main ones like TCE into separate maps with concentration values listed by well instead of in table. The figures in this report are too busy and difficult to use. Very difficult to follow the text to the figure when looking at the plume designations. In addition, the explanation key says exceedances are in the shallow zone, should it be called the shallow/intermediate or intermediate? The Title of the figure is for the intermediate zone.	C/E	Qualifiers were added. The plumes are presented on a single map so the reader can reference the footprints of each contaminant by only having to review a single map. The plume maps are being enlarged to 11x17 format, which should make them more legible. Additionally, adding results next to each well was too difficult to eliminate overlap of data and well locations. This is why the results are presented in table format on the side of the figure. Figure titles were corrected as requested. Shallow/Intermediate references for new wells were updated to "Intermediate (Upper)".	
34	Comparison with Previous Data		EPA suggests mentioning the very high TCE value of 120,000 ug/L (47WW25R) in the most western portion of the plume. That high value is a significant new finding.	C	Note was added about this concentration as follows: "The extent of the TCE plume in 2010 and that observed in the PSI data are similar, with the main difference being the older data has the plume split into separate northern and southeastern plumes. The highest concentration was noted at 47WW25R (120,000 µg/L)."	
35	References		EPA could not locate Shaw, 2007c reference in the text. Please remove if not used.	C	Reference was removed.	
36	Acronym list		Please make the following changes; ACD (remove since not used), 1,2- DCA(define first use on page 3-2), cis-1,2_DCE, (define first use on page 3-2), DCE (remove from list since it is not used a COC, other than metabolites), DO (remove not used in text, but shown on field sheets), ROD (define first use on page 1-1),.	C	Revisions were made as requested.	
37	Appendix D		General Comment. There appears to be a lot of variability in the field parameters between wells especially with SC and DO and in some cases with pH. EPA assumes there are records for meter calibration pre and post. The variability in field parameters at LHAAP is not unusual. Any suggestions on why these are so variable (perched zones, etc). In regard to DO, there are some wells with high DO readings.	C	Water parameter meters were calibrated daily before field use and those calibrations were logged in a field logbook. Field teams did notice the variability in parameters from well to well. Variations are likely due to a combination of water depth, associated contamination, well construction, etc.	

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38	Data validation		EPA noticed that the PCP was run by a herbicide method verses a semi-volatile method. It appears that the lab did this to meet reporting criteria. EPA suggests mentioning this in the body of text. Also suggest adding a small section to the body of text to discuss QA/QC, which would include blanks (i.e., trip blank with TCE in it), replicate, and some of the data flagging info.		An explanation of why PCP was run using the herbicide method has been added to the data validation reports and several sections of the report text. QA/QC results are discussed in the data validation reports. Short discussions have also been added to the report text.	
39	Cross sections		The second figure in the cross sections has mapping features going across the key. Please correct.	C	Figure has been revised accordingly.	
40	Cross sections		It appears that only the new soil boring's and monitoring wells were placed into the old Shaw cross sections and that the interpretation of the lithology was not updated, including the use of the new data, especially in the intermediate zone. EPA does not see the value of cross sections without an updated interpretation. In fact, with the new data, EPA recommends creating entirely new cross sections that are more straight lines or perpendicular to the groundwater flow, instead of jumping around back and forth to wells. This would be useful going through the areas where there is contamination.	E/C	The new well and soil boring locations were added to the Shaw cross-sections to provide context to the replacement well depths with respect to the shallow and intermediate zones. Developing new cross sections is outside the scope of this effort. Lithology and well completion information of the new wells and soil borings will be added.	
41	General comment		Since there appears to be verification errors between the text and figures, another round of editing/verification should be completed to ensure text, tables, raw lab data, and figures agree with each other.	C	Tables, text, and figures were re-checked for accuracy.	
42	Attachment 1, Figures		The Figures are too small to read in the hard copy version of the report.	C	Figures were re-formatted to 11x17 format.	
43	Attachment 2, Tables		The Tables are too small to read in the hard copy version of the report.	C	Tables were re-formatted to 11x17 format.	
44	Appendix H		The cross sections are too small to read in the hard copy version. Also, in the newly installed wells, the screened interval is not shown.	C	Cross-sections were kept at 11x17 size, the same as they were presented in the FS. When the sections were digitized for the PSI report, text was re-formatted to make more legible. The screened intervals and lithology were added.	

Number	Section/Page	Paragraph/ Line	Comment	C,D,E	Response	A,D
45	Figure 8		The results on this map should be split into two separate maps, in other words, the two separate aquifer results. It is too busy and is difficult to interpret from only one map.	D	Replacement wells should be identified as representative of the upper intermediate zone aquifer, but should not be presented separately in the figures. The text will be revised to state that an "R" appended to a well name designates it as a replacement for a dry shallow zone well. The replacement wells were drilled to 40 feet and extended into the intermediate zone sand. The wells were completed in the intermediate sand but also included some clay separating the shallow and intermediate zones. Changing to an 11 x 17 page size and increasing the resolution of the figures will improve the legibility and utility of the figures.	
46	Page 4-3	Surface Water Samples	Have the surface water samples been taken (the soil boring and groundwater sampling were taken from July to September 2018)? The narrative mentions that surface water samples will be collected later due to dry conditions.	-	Surface water sampling is planned for early March.	
47	General Comment	Dry Monitoring Wells	What is the future plan for the monitoring wells that were dry during this investigation but were sampled in 2010.	-	The disposition of the dry wells will be determined during the RD/RA phase.	
48	Groundwater Sampling Sheets	Appendix D	The sheets do not indicate where the pump was placed in the screened interval of each monitoring well, i.e., mid-point, etc. Please explain.	C	A note was added to Section 2.7 that the pump was placed mid-screen for development activities, as follows: "The development pump was placed mid-screen during development activities."	

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00916007

Draft Final

Post-Screening Investigation Report

for LHAAP-47, Plant 3 Area,
Solid Rocket Motor Fuel Production
Longhorn Army Ammunition Plant
Karnack, Texas

March 2019

Prepared For:

U.S. Army Corps of Engineers – Tulsa District

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Contract No. W912BV-15-D-0014
Task Order No. W912BV18F0023

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DRAFT FINAL

POST-SCREENING INVESTIGATION REPORT

FOR

LHAAP-47, PLANT 3 AREA,

SOLID ROCKET MOTOR FUEL PRODUCTION

LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

Prepared For:

U.S. Army Corp of Engineers Tulsa District

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Contract No. W912BV-15-D-0014
Task Order No. W912BV18F0023

March 2019

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Table of Contents

Attachments

Attachment 1: Figures

Attachment 2: Tables

Appendices

Acronyms and Abbreviations

1,2-DCA	1,2-dichloroethane
µg/L	micrograms per liter
AECOM	AECOM Technical Services, Inc.
bgs	below ground surface
cis-1,2-DCE	cis-1,2-dichloroethylene
COC	contaminant of concern
DNT	dinitrotoluene
DPT	direct push technology
$^{GW}GW_{Ing}$	Tier 1 residential groundwater
GWTP	groundwater treatment plant
HSA	hollow-stem auger
I.D.	inner diameter
IWWP	Installation Wide Work Plan
LHAAP	Longhorn Army Ammunition Plant
mg/L	milligrams per liter
MSL	above mean sea level
NPL	National Priorities List
PCE	tetrachloroethene
PCL	Protective Concentration Level
PID	photoionization detector
PSI	Post Screening Investigation
PVC	polyvinyl chloride
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SVOC	semi-volatile organic compound
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TCLP	toxicity characteristic leaching procedure
TNT	Trinitrotoluene
TRRP	Texas Risk Reduction Program
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound
WP	Work Plan

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1 Introduction

This Post-Screening Investigation (PSI) Report has been prepared for the former Longhorn Army Ammunition Plant (LHAAP) site LHAAP-47 (Plant 3 Area), located in Karnack, Texas. The purpose of this PSI Report is to summarize the results of environmental investigations conducted at LHAAP-47 between April and September 2018.

This document describes the PSI activities completed at site LHAAP-47. The PSI effort was performed in accordance with the Installation Wide Work Plan (IWWP) (AECOM, 2014) and PSI Work Plan (WP) (AECOM, 2016). The IWWP and PSI WP were reviewed by and concurrence was obtained from the Texas Commission on Environmental Quality (TCEQ) and the U.S. Environmental Protection Agency (USEPA).

The objective of this PSI is to re-assess and update the groundwater contaminant concentrations for the shallow and intermediate groundwater due to old and limited data. The PSI data will be used to support revision of the Draft Final Record of Decision (ROD), as necessary.

A Remedial Investigation was completed in 2002 for LHAAP-47, and a Final Feasibility Study (FS) was completed in July 2011. The LHAAP-47 Proposed Plan was finalized in December 2012 and the LHAAP-47 ROD has been drafted and received regulatory review/comments. Implementation of the PSI WP and completion of the PSI Report will be followed by a Revised Draft Final ROD (accounting for PSI results and addressing unresolved regulatory comments).

1.1 LHAAP Background

LHAAP is located in eastern Texas, in the northeastern corner of Harrison County (**Figure 1**). The former installation occupied 8,416 acres between State Highway 43 at Karnack, Texas, and the western shore of Caddo Lake. Approximately 7,100 acres have transferred to the U.S. Fish and Wildlife Service and now comprise the Caddo Lake National Wildlife Refuge. The nearest cities are Marshall, Texas, located approximately 14 miles southwest of the site, and Shreveport, Louisiana, located approximately 40 miles southeast of the site. Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east (AECOM 2016).

Due to releases of contaminants of concern (COCs) from operations at the facility, LHAAP was placed on the Superfund National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination associated with the NPL listing of LHAAP began in 1990. The Army, USEPA, and TCEQ entered into a Comprehensive Environmental Response, Compensation, and Liability Act Section 120 Federal Facilities Agreement for remedial activities at LHAAP, effective December 30, 1991. In 1997, LHAAP was placed on inactive status and classified by the Army Armaments, Munitions, and Chemical Command as excess property (AECOM 2016).

1.2 LHAAP-47 Background

The LHAAP-47 site area is located in the north-central portion of the former plant, and occupies an area of approximately 275 acres (**Figure 2**). When operational, Plant 3 produced rocket motor, pyrotechnic, and illumination devices. Construction of the site began in July 1953, and the plant remained active until approximately 1997. Industrial solid wastes and hazardous wastes, such as parts cleaners and spent solvents, may have been generated by the activities conducted at Plant 3. Fifty waste process sumps and three waste rack sumps were located at LHAAP-47 (AECOM, 2016).

This site began producing rocket motors in 1954, and continued to do so until the early 1980s. Some of the rocket motor production facilities were later converted to produce pyrotechnic and illumination devices and were active until approximately 1997. Operations integral to this activity were vapor degreasing, grit blasting, particle size reduction, mixing, and blending, Teflon coating, and vacuum and pressure casting of solid rocket fuel motors.

Perchlorate was previously detected in site soil samples. Volatile Organic Compounds (VOCs), metals, and perchlorate were previously detected in groundwater.

1.2.1 Lithology

The subsurface geology at LHAAP consists primarily of a thin veneer of Quaternary alluvium, mantling Tertiary age formations of the Wilcox and Midway Groups. Underlying these sediments are the Cretaceous age formations of the Navarro and Taylor Groups (Jacobs 2002).

The stratigraphic thickness of the Wilcox Group ranges from a maximum 350 feet in the northwestern corner of LHAAP to approximately 130 to 140 feet along the eastern side of the facility, near Caddo Lake. The Wilcox Group constitutes most of the unconsolidated sediments underlying LHAAP. It consists of interbedded fine- to medium-grained sands, silts, and clays that are variously light gray, red, brown, and/or tan and contain occasional seams of lignite. This Eocene series undifferentiated formation was deposited in a regressive fluvial-deltaic and transgressive marine environment and shows considerable heterogeneity across the facility (Jacobs 2002).

The Midway Formation is generally encountered at depths of approximately 200 to 300 feet and is a thick, calcareous to non-calcareous clay, containing some sand. The exact thickness of the Midway Formation is difficult to determine because it cannot be readily differentiated from the underlying upper Navarro Group (Upper Cretaceous). These formations form the base of the overlying Eocene aquifer system, effectively isolating it from deeper flow systems (Jacobs 2002).

In general, boring logs generated across LHAAP show the Wilcox Group typically consist of a series of three sandy water-bearing zones separated by layers of silty clay. The uppermost portion of the Wilcox Group at LHAAP consists of medium plastic sandy silts and clays, which range from approximately 5 to 15 feet thick. These surficial sediments are underlain by the shallow saturated zone, which varies from 10 to 20 feet thick. This sand zone consists of silty, fine-grained sand, containing some silt and clay lenses. At the ground surface, this zone is dry to moist and becomes saturated 15 to 20 feet below ground surface (bgs). A 5- to 20-foot thick, medium to highly plastic silt and clay aquitard underlies the shallow saturated zone. An intermediate saturated sand zone, consisting of a fine to medium silty sand, is encountered below the aquitard, 30 to 50 feet bgs. The intermediate saturated zone is generally less silty than the shallow saturated zone and exhibits a higher hydraulic conductivity. Beneath the intermediate saturated zone, a 5- to 30-foot silt to silty clay layer is encountered. Underlying this silt to silty clay layer is a massive, homogeneous, silty, clayey, fine sand that continues to the top of the underlying Midway Formation (Jacobs 2002).

Boring logs generated during the PSI field effort reveal significant lithologic heterogeneity across short distances. Based on previous subsurface data, the uppermost water-bearing zones have been designated as the Shallow Zone and the Intermediate Zone. The Shallow Zone consists of the surface material above the first aquitard, while the Intermediate Zone consists of the material below the first aquitard.

During the PSI drilling activities, the Shallow Zone materials were noted as various mixtures of sands, silts, and clays (predominantly silts and clays). In the LHAAP-47 site area, the first aquitard, a

thin (1- to 2-foot) clay layer, was located approximately 20 to 25 feet bgs. The underlying Intermediate Zone materials were noted as silts and sands, with intermixed clay zones. All boring logs completed for the PSI field effort are included in **Appendix A**. PSI well boring depths, completion intervals, and water levels have been added to the geologic cross sections from the FS (Shaw, 2011) and are included in **Appendix H**.

1.2.2 Surface Water Hydrology

Surface water at LHAAP drains to the northeast into Caddo Lake via four drainage systems: Saunder's Branch, Harrison Bayou, Central Creek, and Goose Prairie Creek. Caddo Lake is a part of Big Cypress Bayou. The headwaters of Goose Prairie Creek are located near the northwestern corner of the plant, and consist of one larger creek and several smaller tributaries. Goose Prairie Creek flows across the northern edge of the installation and drains approximately 30 percent of LHAAP (Jacobs 2002).

Specific to LHAAP-47, there are several surface water drainages within the site area. Shallow ditches which collect water during rain events are present along each side of all the asphalt roads, eventually draining to Goose Prairie Creek. Goose Prairie Creek runs along the southern edge of the site area and extends east of the site, discharging to Caddo Lake.

1.2.3 Hydrogeology

Groundwater and geologic data obtained during historical field activities at LHAAP indicate varying degrees of heterogeneity within the subsurface hydrogeology across the facility. This is indicative of the fluvial-deltaic-type depositional environment typical of Quaternary and Wilcox Group sediments underlying LHAAP. The unconsolidated sediments of the Wilcox Group consist primarily of elongated, interconnected, channel-fill sand deposits within alluvial belts that are interbedded with less permeable interchannel sediments. The interbedded, less permeable deposits form aquitards that limit the flow between the saturated zones. Subsurface hydrogeology at LHAAP can generally be characterized as consisting of three saturated water-bearing zones (a shallow zone, an intermediate zone, and a deep zone), which are separated by clay aquitards (Jacobs 2002).

Groundwater generally occurs under unconfined conditions, whether in the alluvial or Wilcox Group strata. Perched and localized confining conditions frequently occur within the Wilcox Group deposits because of the high clay content and highly variable stratigraphy. The base of the Wilcox Group water-bearing zone beneath LHAAP is defined by the contact of the Wilcox Group with the underlying Midway Group. The Midway Group consists predominantly of very low permeability clays that yield little or no water. The Wilcox Group is considered the base of fresh water in the area (Jacobs 2002).

Figures 3 and **4** show the groundwater elevations collected in September 2018, which reveal a northeast groundwater gradient for the Intermediate Zone toward Caddo Lake. The Shallow Zone is predominantly dry and has little to no flow.

1.2.4 Shallow, Shallow/Intermediate, and Intermediate Zone Designations

Historically, monitoring wells at LHAAP-47 have been classified as being completed in three water-bearing zones:

- Shallow Zone wells
- Shallow/Intermediate Zone wells
- Intermediate Zone wells.

The well designations used in the 2011 FS are unchanged, but for the purposes of this report, the Shallow/Intermediate well data collected during the PSI are presented with the intermediate zone data. This includes the following pre-existing Shallow/Intermediate wells:

- 47WW06
- 47WW09
- 47WW14
- 47WW23
- 47WW31
- 47WW32
- 47WW33
- LHSMW41
- LHSMW60

All new PSI wells were installed in the Intermediate Zone, even those that were intended as Shallow Zone replacement wells (9 wells), since the Shallow Zone was dry. All of the replacement wells that were completed in the upper Intermediate Zone (to a maximum depth of 40 feet bgs) are referred to as "Intermediate (Upper)" and have names that include an "R" suffix. An additional five new wells (47WW39 through 47WW43) were also completed similar to the replacement wells to a maximum depth of 40 feet bgs. These 14 wells screen the upper sand of the Intermediate Zone, and may also screen sections of the aquitard that separates the Shallow from the Intermediate Zone, which is discussed in more detail below.

Pre-existing wells that were completed in the Shallow Zone typically had completion depths of 20 feet or less, and were found to be dry (11 during the PSI field investigation) or had 2 feet or less of water (5 during the PSI field investigation). Existing Shallow/Intermediate wells, on the other hand, have completion depths that generally range between 35 and 55 feet, and all were found to contain groundwater. An important observation noted during the PSI field investigation and supported by a review of hydrogeological data, boring logs, and cross-sections presented in the FS, is the existence of a wide-ranging but discontinuous clay layer ranging in depth from 20 to 35 feet bgs. It is believed this clay layer, or aquitard, separates the Shallow Zone from the Intermediate Zone. This discontinuous clay unit is also suspected of having an irregular surface, which would account for isolated pockets of perched groundwater that were found in several Shallow Zone wells.

For development of both groundwater elevation maps and plume maps, Shallow/Intermediate Zone wells were included with Intermediate Zone wells.

1.3 Previous Investigations and Remedial Actions

Environmental media (soil, groundwater, surface water, sediment, and sump contents) at LHAAP-47 have been the subject of numerous investigations to identify potential contamination, which are summarized below.

Summary of Previous Investigations at LHAAP-47

Pre-Phase I (Jacobs 2002)

EPS 1984
- Environmental Protection Systems, Inc. installed one monitoring well and collected a groundwater sample

BCM 1992
- Inventory of the waste process sumps at this site

United States Army Corps of Engineers (USACE) 1994
- Inventory of the waste process sumps and waste rack sumps at this site

Phases I-III (Jacobs 2002)

USACE, Phase I 1993
- Collected sump content sample for laboratory analysis
- Completed borings at sump locations and collected soil samples

USACE, Phase II 1994
- Collected soil samples from monitoring well locations and from ditch and drainage ways
- Installed monitoring wells and collected groundwater samples from each well

USACE, Pre-Phase III 1996
- Determined locations for Phase III monitoring wells by delineating plume using site characterization and analysis penetrometer system (eight locations)

Jacobs, Phase III 1998
- Collected soil samples at waste process sump locations
- Collected surface water and sediment samples
- Collected soil samples from locations
- Installed monitoring wells and collected groundwater samples from each of the new wells and existing wells

Remedial Investigation (Jacobs 2002)

- USACE collected two rounds of groundwater samples in 1996 (Jacobs 2002)
- In 1999 and 2000, collected soil samples for perchlorate and total petroleum hydrocarbons (Jacobs 2002)
- In 2000, installed and sampled four new monitoring wells and collected groundwater samples from existing wells (Jacobs 2002)
- In 2001, collected groundwater samples for perchlorate (Jacobs 2002)

Additional Investigations

- In 2001, collected soil samples for perchlorate investigation (Lynntech 2001)
- In 2002, collected soil samples as part of the perchlorate investigation (STEP 2005)
- In 2003, collected groundwater and soil samples at two locations as part of the Phase II Environmental Site Assessment (Plexus 2005)
- In 2004, installed four monitoring wells and collected groundwater samples for VOC analysis (Shaw 2007b)
- In 2006, collected additional soil samples from select sumps (Shaw 2007a and 2008)
- In 2007, installed one monitoring well and collected samples for natural attenuation evaluation (Shaw 2011) and for geochemistry evaluation (Shaw 2011)
- In 2008, installed four monitoring wells and collected groundwater samples for VOC analysis (Shaw 2011)
- In 2009, collected additional groundwater samples for VOC analysis (Shaw 2011)
- In 2010, installed 2 monitoring wells and 18 temporary monitoring wells, collected additional groundwater samples for VOC, perchlorate, metals, semi-volatile organic compounds (SVOC), and monitored natural attenuation analysis, and collected additional soil samples for perchlorate analysis (Shaw 2011).

The major COCs in groundwater are listed below:

COCs in groundwater			
Anions	• Perchlorate	**Explosives**	• 2,4,6-trinitrotoluene • 2,4-dinitrotoluene • 2,6-dinitrotoluene
VOCs	• 1,1-Dichloroethene • 1,2-Dichloroethane • Acetone • Chloroform • cis-1,2-Dichloroethene • Tetrachloroethene • trans-1,2-Dichloroethene • Trichloroethene (TCE) • Vinyl chloride	**Metals**	• Aluminum • Antimony • Arsenic • Cadmium • Chromium • Cobalt • Manganese • Nickel • Silver • Strontium • Thallium • Tin • Vanadium
SVOCs	• Bis(2-ethylhexyl)phthalate • Pentachlorophenol		

1.4 Organization of Report

This report has been organized in the following sections:

- *Section 1: Introduction* – summarizes the site background including previous investigation and remediation activities
- *Section 2: Investigation Activities* – describes the completed field activities
- *Section 3: Investigation Findings* – provides a presentation of the data and analyzes the findings
- *Section 4: Conclusions* – provides main conclusions
- *Section 5: References* – provides a list of references cited in the document.

This PSI Report also includes several appendices supporting the main text:

- *Appendix A:* Soil Boring Logs
- *Appendix B:* Well Completion Forms
- *Appendix C:* Well Development Forms
- *Appendix D:* Well Sample Forms
- *Appendix E:* Soil Boring Raw Analytical Data Packages
- *Appendix F:* Monitoring Well Raw Analytical Data Package
- *Appendix G:* Data Validation Report
- *Appendix H:* Geologic Cross Sections

2 Investigation Activities

This section presents information on the completed LHAAP-47 PSI activities.

Per the PSI WP (AECOM 2016), the following activities were planned:

Shallow Zone Groundwater Re-Assessment

- Determine the Shallow Zone groundwater elevations, potentiometric surface, and flow directions by gauging all existing Shallow Zone monitoring wells at the Site. *(Completed, a majority of Shallow Zone wells were dry, per **Figure 3.**)*
- Determine if groundwater is present in the historically dry wells at the Site and whether groundwater samples can be collected using the sampling procedures in the Installation-Wide Work Plan (AECOM 2014). *(Note: this task was completed and all historically dry wells remained dry.)*
- If groundwater samples can be collected, then replacement monitoring wells will not be installed for the PSI. However, up to ten Shallow Zone replacement wells may be installed at the locations identified below for historically dry wells that remain dry *(Note: the shallow zone was dry at all replacement and new well locations, therefore the borings were advanced to depths of approximately 40 feet, into the Intermediate Zone.)*:
    - Install a 4-inch diameter monitoring well adjacent to monitoring well LHSMW46 near Building 45-E; following well development, collect and analyze a groundwater sample for VOCs. *(Note: replacement well 47WW46R was completed.)*
    - Install a 4-inch diameter monitoring well in the vicinity of 47WW25 (near 47DPT14); following well development, collect and analyze a groundwater sample for VOCs. *(Note: replacement well 47WW25R was completed.)*
    - Install a 4-inch diameter monitoring well in the vicinity of LHSMW48 east of Building 41-E; following well development, collect and analyze a groundwater sample for VOCs. *(Note: replacement well was not completed, drilling showed no shallow groundwater present in this area.)*
    - Install one 4-inch diameter monitoring well in the vicinity of LHSMW56; following well development, collect and analyze a groundwater sample for VOCs. *(Note: replacement well LHSMW56R was completed.)*
    - Install a 4-inch diameter monitoring well approximately 100 feet south of 47WW08; following well development, collect and analyze groundwater samples for VOCs and perchlorate. *(Note: replacement well 47WW08R was completed.)*
    - Install a 4-inch diameter monitoring well in the vicinity of monitoring well LHSMW43; following well development, collect and analyze a groundwater sample for VOCs. *(Note: replacement well LHSMW43R was completed.)*
    - Install a 4-inch diameter monitoring well in the vicinity of monitoring well 47WW26; following well development, collect and analyze a groundwater sample for perchlorate. *(Note: replacement well 47WW26R was completed, although location had to be moved twice before finding groundwater.)*
    - Install a 4-inch well in the vicinity of 47WW11; following well development, collect and analyze a groundwater sample for perchlorate. *(Note: replacement well 47WW11R was completed.)*
    - Install a 4-inch well along the northeast corner of Building 54-G as a substitute for dry wells LHSMW39 and LHSMW42; following well development, collect and analyze a groundwater sample for perchlorate. *(Note: replacement well LHSMW42R was completed.)*
    - Install a 4-inch well in the vicinity of LHSMW55; following well development, collect and analyze a groundwater sample for perchlorate. *(Note: replacement well LHSMW55R was completed.)*

- The Shallow Zone replacement monitoring wells will be installed to a maximum depth of 40 ft bgs and constructed with a 10 foot screen. If groundwater is not encountered in the borehole at any of the proposed replacement monitoring well locations, the borehole will be properly abandoned in accordance with procedures documented in the Final Installation-Wide Work Plan (AECOM 2014). *(Completed.)*
- Advance up to seven DPT borings into the Shallow Zone and collect up to two discrete groundwater grab samples utilizing a point-in-time groundwater sampler (i.e. sealed-screen sampler or equivalent) from each boring to assess current groundwater conditions as a basis for siting replacement or additional wells. *(Completed six borings [SB-01 through SB-06] and collected nine samples below the shallow zone, which was dry [see **Table 1** and **Figure 5**].)*
    - Groundwater grab samples from the DPT borings will be analyzed on a 48-hour turnaround time for VOCs and/or perchlorate. *(Completed.)*
    - The DPT borings will be advanced to a maximum depth of 40 ft bgs. Depending on the depth at which Shallow Zone groundwater is encountered, ideally one discrete groundwater grab sample will be collected between 20 and 30 ft bgs, and the second discrete sample will be collected between 30 and 40 ft bgs. *(Samples were collected at various depths based on ability to reach depth and presence of groundwater. Sampling intervals for all groundwater grab samples are shown in **Table 1.**)*
    - The need to advance and collect discrete groundwater grab samples from a seventh DPT boring will be determined based on whether the groundwater results from the first six locations are sufficient to re-assess VOCs and perchlorate in groundwater in the Shallow Zone to inform the ROD. *(The results for the first six locations were determined to be sufficient and a seventh boring was not completed.)*
- Install 4-inch diameter permanent Shallow Zone monitoring wells in up to three DPT borings. These borings will be selected after a thorough review of the groundwater grab sample results from the DPT borings. The wells will be installed to a maximum depth of 40 ft bgs and constructed with a 10-ft screen. *(Because the shallow zone was dry, permanent wells were installed in the upper intermediate zone at four shallow borings [SB-03, SB-04, SB-05, and SB-06; reference **Figure 5**].)*
- Approximately 30 additional pre-existing monitoring wells will be redeveloped and sampled for VOCs, and/or perchlorate, depending on their location within the source areas. In addition, analysis for pentachlorophenol, bis(2-ethylhexyl)phthalate, 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6- dinitrotoluene, and the following metals: aluminum, antimony, arsenic, cadmium, chromium, cobalt, manganese, nickel, silver, strontium, thallium, tin, and vanadium, depending on their location within the source areas, will be conducted. The wells to be sampled will be proposed after review of the groundwater data collected during the DPT assessment and the list of proposed wells will be provided to the regulatory agencies for review prior to sampling. Therefore, a total of up to 43 monitoring wells in the Shallow Zone will be sampled for the PSI. *(As a result of the dry conditions in the shallow zone identified during the site reconnaissance, a total of 49 wells were investigated to determine the presence of water and development potential. From this initial investigation, 20 wells were found to be either dry, had insufficient water levels to develop, or would not recharge during development. In total, 11 existing wells, 9 replacement wells, and 9 new wells were developed and sampled.)*

Intermediate Zone Groundwater Re-Assessment

- Determine the Intermediate Zone groundwater elevations, potentiometric surface, and flow directions by gauging all existing Intermediate Zone monitoring wells at the Site. *(Completed.)*
- Advance up to six DPT borings into the Intermediate Zone and collect up to two discrete grab groundwater samples from each location using a point-in-time groundwater sampler (i.e., sealed-screen sampler or equivalent) to re-assess TCE and/or perchlorate in

groundwater. Prior to drilling DPT borings into the Intermediate Zone a surface casing will be constructed to a depth of 40 feet bgs to isolate the borehole from the Shallow Zone. Groundwater grab samples from these Intermediate Zone borings will be analyzed on a 48-hour turnaround time for VOCs and/or perchlorate. *(Five borings were completed; see **Figure 6.**)*
    - The DPT borings will be advanced to a maximum depth of 65 ft bgs. Depending on the depth at which Intermediate Zone groundwater is encountered, ideally one discrete groundwater grab sample will be collected between 45 and 55 ft bgs, and the second sample will be collected between 55 and 65 ft bgs. *(Samples were collected at various depths based on ability to reach depth and presence of groundwater. Sampling intervals for all groundwater grab samples are shown in **Table 1.**)*
    - The need to drive and collect a discrete groundwater grab sample from a sixth DPT boring will be determined based on whether the groundwater results from the first five locations are sufficient to re-assess VOCs and perchlorate in groundwater in the Intermediate Zone to inform the ROD. *(The results for the first six locations were determined to be sufficient and a sixth boring was not completed.)*
- Install 4-inch diameter Intermediate Zone monitoring wells (after either temporary or permanent surface casing has been installed to 40 feet bgs) in up to two DPT borings. These borings, along with the total depth of the wells that will be installed in each, will be selected after a thorough review of the groundwater grab sample results from the DPT borings. The wells will be installed to a maximum depth of 65 ft bgs and constructed with a 10-ft screen. *(Permanent wells were installed at two borings [SB-07i and SB-08i], and one location downgradient of SB-07i [47WW46]; see **Figure 6.**)*
- Two new Intermediate Zone monitoring wells will be installed (after either temporary or permanent surface casing has been installed to 40 feet bgs) to a maximum depth of 65 ft bgs and constructed with a 10 foot screen to re-assess VOCs in the Intermediate Zone.
    - Install a 4-inch diameter monitoring well approximately 1,200 ft east-northeast of monitoring well 47WW34; following well development, collect and analyze a groundwater sample for VOCs. *(Completed as well 47WW44.)*
    - Install a 4-inch diameter monitoring well approximately 1,000 ft east-northeast of monitoring wells 47WW09; following well development, collect and analyze a groundwater sample for VOCs. *(Completed as well 47WW39.)*
- Approximately 10 additional pre-existing Intermediate Zone monitoring wells will be redeveloped and sampled for VOCs and/or perchlorate, depending on their location within the source areas. In addition, analysis for pentachlorophenol, bis(2-ethylhexyl)phthalate, 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6- dinitrotoluene, and the following metals: aluminum, antimony, arsenic, cadmium, chromium, cobalt, manganese, nickel, silver, strontium, thallium, tin, and vanadium, depending on their location within the source areas, will be conducted. The wells to be sampled will be proposed after review of the groundwater data collected during the DPT assessment and the list of proposed wells will be provided to the regulatory agencies for review prior to sampling. Therefore, a total of up to 14 monitoring wells in the Intermediate Zone will be sampled for the PSI. *(Ten existing wells were investigated, one of which was found to be dry. Four new wells were installed and included as intermediate.)*

2.1 Summary of Activities

The PSI fieldwork was divided into multiple field efforts:

- Field reconnaissance
- Vegetation clearance

- Installation of surface casings for Intermediate Zone soil borings
- DPT sampling of Shallow and Intermediate Zone soil borings
- Phase I monitoring well installation, development, and sampling
- Phase II monitoring well installation, development, and sampling
- Synoptic water level measurements
- Investigation-derived waste disposal/cleanup activities
- Well survey.

A summary of each activity is presented below.

2.2 Field Reconnaissance

A preliminary site reconnaissance was performed at LHAAP-47 on 29 March 2018. The intent was to inspect and gauge ten historically dry Shallow Zone groundwater wells to determine if the wells contained water. The majority of these wells had been identified as dry as early as 2010 (AECOM 2016). The wells included:

- 47WW08
- 47WW11
- 47WW25
- 47WW26
- LHSMW39 / LHSMW42
- LHSMW43
- LHSMW46
- LHSMW48
- LHSMW55
- LHSMW56

Water level gauging of the dry wells was conducted using a GeoTech water level meter. Decontamination procedures, as described in the IWWP (AECOM, 2014), were followed to decontaminate the water level meter between recording measurements at each well. Seven of the wells listed above were found to be dry. The dry wells included 47WW11, 47WW25, 47WW26, LHSMW42, LHSMW43, LHSMW46, and LHSMW56. The remaining wells either could not be located or were found to present a biological hazard (i.e., presence of hornet nests in the protective lid). However, based on a review of the shallow completion depth of these wells and comparison to drill logs and well construction forms for wells measured, it was projected that these wells were also dry. Consequentially, all ten wells were scheduled for replacement.

2.3 Vegetation Clearance

The PSI effort began with vegetation clearance. The LHAAP-47 site area is densely vegetated and is not actively maintained.

A local construction contractor mobilized to the site on April 30, 2018, to begin vegetation clearance. All clearance activities were completed May 5. Planned boring locations were staked, the locations recorded using a handheld GPS, and then paths were opened leading to each boring location. The clearance was performed using a bulldozer, which was able to scrape away underbrush and remove small diameter trees.

Initially, it was only planned to clear boring locations, but site conditions made it apparent that additional clearance would be necessary to access historical monitoring wells scheduled for re-development and sampling. Therefore, clearance was also performed to make paths to these wells. Finally, many of the roads at the site had downed trees and encroaching branches/canopy, which also had to be cleared.

2.4 Surface Casing Installation for Intermediate Zone Borings

The vegetation clearance effort was followed by surface casing installations at five Intermediate Zone boring locations. The objective of installing the surface casing was to prevent potential downward migration of contamination from the Shallow Zone to the Intermediate Zone.

For subsurface hydrogeology, the Shallow Zone is defined as the uppermost sand unit. This sand unit is underlain by a clay layer, which is then underlain by a second sand unit, generally referred to as the Intermediate Zone, followed by another clay layer. Although these units are identifiable throughout most of the site, they are not entirely laterally continuous, particularly to the east, and are not of uniform thickness.

The casing installations began on May 15, 2018, for the five Intermediate Zone boring locations and were designated SB-07i through SB-11i. Intermediate boring locations are shown on **Figure 6**.

The surface casings were installed using 6.25-inch flight augers to drill to the depth of the aquitard. Cuttings were logged until they revealed a clay aquitard. Then drilling was discontinued and 4-inch inner diameter (I.D.) Schedule 40 polyvinyl chloride (PVC) casing was installed and grouted into place.

The first clay layer was usually encountered 21 to 24 feet bgs, except for the northernmost boring location, SB-11i, where it was encountered at 35 feet bgs. Casings were set at 22, 24, 21, 22, and 35.5 feet bgs for borings SB-07i, 08i, 09i, 10i, and 11i, respectively.

No staining or visible signs of contamination were noted during drilling activities. A slight odor was noted at SB-09i, but it was not typical of solvent contamination. The drillers reported the odor as something they encounter drilling in landfill areas. Soil boring logs are included in **Appendix A**.

2.5 Soil Boring Installation and Sampling

Following surface casing installation for the intermediate zone wells, soil borings were completed at eleven locations across the site area. Six of the soil borings (SB-01 through SB-06) were completed in the upper Intermediate Zone, no deeper than 40 feet bgs, but below the clay underlying the Shallow Zone. Five of the borings (SB-07i through SB-11i) were completed in the Intermediate Zone (maximum depth of 65 feet bgs). **Figures 5** and **6** show the locations of the soil borings, along with previous well data and plumes for TCE and perchlorate.

Soil borings were completed with a combination of hollow-stem auger (HSA) and Geoprobe direct-push technology (DPT). The proposed plan was to install all soil borings using DPT, however, due to mechanical problems with the DPT rig, a HSA was used at shallow borings SB-01, SB-02, and SB-06. The remaining borings were completed using DPT.

For HSA borings, 8.25-inch outer diameter augers were used to drill boreholes and obtain soil samples. A 5-foot continuous split barrel sampler was utilized to obtain continuous core samples for logging. DPT borings were completed using a Geoprobe 7720DT with 2.25-inch drill rods.

The soil boring effort was conducted from May 21, 2018, through June 6, 2018. Up to two groundwater samples were collected from each boring as the borehole was advanced. Temporary 1-inch PVC casing, with a 5-foot screen interval, was installed at each sampling depth to allow for collection of groundwater samples with a 0.5-inch bailer.

Soil cores were scanned with a photoionization detector (PID) during logging activities. Borings SB-05 and SB-07i showed elevated PID readings (up to 10,000 parts per billion in SB-05 and up to 8,000 parts per billion in SB-07i). Soil boring logs are included in **Appendix A**.

The number of samples collected at each boring was dependent on the corresponding water level and corresponding head (i.e., water volume in the casing). The proposed plan was to collect two groundwater samples from each boring, one shallow and one deep. For borings SB-01, SB-04, SB-06, and SB09i, only one sample was collected. For SB-10i, the entire boring was clay and no water was produced before hitting refusal at 36 feet bgs. Therefore, no sample was collected at SB-10i.

Reaching the desired total depth was problematic at some DPT boring locations. This was usually due to fat clays or wet sands locking up the DPT rods. For those locations, a sample was collected at the terminus of the boring. Although sampling depths were predefined in the PSI WP, sample depths were adjusted based on water levels and final depth achieved at each boring location. **Table 1** presents the sampling depth interval for each sample collected. Shallow samples are denoted with an “A” at the end of the sample ID, while deep samples are denoted with a “B” at the end of the sample ID.

Several groundwater samples had large amounts of silty sediment in them. The single sample collected at SB-09i was so silty the laboratory reported the results as soil, with units of micrograms per kilogram. All other samples were reported as water, with units of micrograms per liter.

After each boring was completed and sample(s) collected, the borehole was abandoned by grouting. Soil cuttings and decontamination fluids were drummed (separately) and left at the respective boring location. Drums were labeled to document their contents and associated boring ID. Finally, all five of the previously installed surface casings were pulled during the grouting process.

All groundwater samples collected from the borings were analyzed for VOCs and perchlorate.

2.6 Phase I Monitoring Well Installation

During the final portion of the soil boring effort, Phase I monitoring well installation was initiated. The Phase I well installation effort began on May 29, 2018, and was completed on June 22, 2018. None of the shallow dry well replacements could be installed in the Shallow Zone due to lack of water. All 10 of the following wells were completed in the upper Intermediate Zone:

- 47WW08R
- 47WW11R
- 47WW25R
- 47WW26R

- 47WW39
- LHSMW42R
- LHSMW43R
- LHSMW46R
- LHSMW55R
- LHSMW56R.

Nine of the ten installed wells were replacement wells for historical wells that were dry (replacement well IDs denoted with an "R" at end of ID). Replacement wells were typically installed directly next to the corresponding historically dry well. For wells installed directly next to a dry well, flight augers were used to drill to the depth of the historical well, and then HSA was used to sample/log the deeper material to the boring terminus. Boring logs were then completed by merging the historical well log with the new boring log. Wells 47WW08R, 47WW26R, and LHSMW42R were not completed directly next to their corresponding dry wells, so the entire boring was logged for these wells. Well 47WW39 was installed at an entirely new location, to provide data at the eastern edge of the site to define the extent of contamination. Phase I well locations are shown on **Figure 5**.

A replacement monitoring well was planned for historically dry well LHSMW48, but the initial boring completed for the replacement well installation was dry after waiting overnight to see if the boring produced water. Since the boring remained dry, it was decided to forgo a replacement well for LHSMW48. Additionally, two borings were drilled in an attempt to install a replacement for historically dry well 47WW26. The first boring location was dry, so a second boring was completed at another location. While the second boring produced water overnight (albeit not readily), the boring cores reflected solid clay from the ground surface to 40 feet bgs. It was decided to install a permanent well (47WW26R) at this location. The remaining borings where wells were installed produced water during drilling activities. Completion details for all wells installed during the PSI are included below.

Each Phase I well was completed below the Shallow Zone sand and underlying clay aquitard to a maximum depth of 40 feet bgs, into the upper Intermediate Zone and overlying aquitard. The replacement wells, in proximity of the cross section prime line, have been added to cross sections A-A', B-B", D-D', and E-E" (**Appendix H**), which shows their completion in the upper Intermediate Zone. Wells were drilled with a combination of HSA and flight augers with a 10.25-inch outer diameter. HSA was utilized to install the monitoring wells, with a 5-foot continuous split barrel sampler utilized to obtain continuous core samples for logging. Wells were completed with 4-inch I.D. PVC casing and screen. Screens with a 0.010-inch slot and 10 feet in length were installed at the bottom of each well. A 20/40 sieve silica sand pack was placed from the well terminus to a few feet above the top of the screen. Then a 2-foot minimum bentonite seal (3/8-inch pellets) was added on top of the sand pack and the remaining boring annulus was grouted to surface (by tremie pipe) using Type I/II Portland Cement with 3 to 5 percent bentonite.

Surface completion activities (well pad, well protector, bollards, labeling, and painting) were performed at a later date, allowing for the grout to set up and be topped off, if needed, prior to surface completion.

Soil cuttings and decontamination fluids were drummed (separately) and left at the respective well location. Drums were labeled to document their contents and associated well location. Boring logs and well completion forms for Phase I wells are included in **Appendix A** and **Appendix B**, respectively.

Well ID	Type	Well Completion Details					
		Total Depth (ft bgs)	Screen Interval (ft bgs)	Filter Pack (ft bgs)	Bentonite Seal (ft bgs)	Screen and Casing Diameter (in)	Borehole Diameter (in)
47WW08R	Replacement	39.5	28.8-38.8	26.8-38.8	24.6-26.8	4	10.25
47WW11R	Replacement	35.5	25-35	23-35.5	21-23	4	10.25
47WW25R	Replacement	40	29.5-39.5	27-40	24-27	4	10.25
47WW26R	Replacement	40	29.3-39.3	26.5-39.8	23.8-26.5	4	10.25
47WW39	New	40	29-39	27-39	23-27	4	8.25
47WW40 (SB-03)	New	39	29-39	27-39	25-27	4	10.25
47WW41 (SB-04)	New	36.5	26-36	24-36	22-24	4	10.25
47WW42 (SB-05)	New	40.5	30-40	28-40	26-28	4	10.25
47WW43 (SB-06)	New	33.5	23-33	21-33	18.5-21	4	10.25
47WW44	New	60	48.5-58.5	45.5-59	42-45.5	4	14 / 8
47WW45 (SB-07i)	New	48	37.5-47.5	30-48	26-30	4	14 / 8
47WW46	New	55	44.5-55.5	42-55	38-42	4	14 / 8
47WW47 (SB-08i)	New	52	41.5-51.5	39-52	36.5-39	4	14 / 8
LHSMW42R	Replacement	38.5	28-38	26.2-38.5	23.3-26.2	4	10.25
LHSMW43R	Replacement	34.5	24-34	21.9-34.5	19.2-21.9	4	10.25
LHSMW46R	Replacement	39.5	29-39	27.1-39.5	24-27.1	4	10.25
LHSMW55R	Replacement	35.5	25-35	23-35	21-23	4	10.25
LHSMW56R	Replacement	35	24.5-34.5	22.5-35	20.5-22.5	4	10.25

2.7 Phase I Monitoring Well Development

Well development was conducted in combination with Phase I monitoring well installation. Phase I well development began on June 25, 2018, and was completed July 17, 2018. Well development was performed for all Phase I installed monitoring wells, plus 15 pre-existing monitoring wells.

The development team attempted to develop 34 pre-existing wells, but only 15 were able to be developed. Development was initiated at four wells that did not recharge, and therefore could not be developed. These wells include 47WW13, 47WW21, 47WW36, and LHSMW57.

Sixteen pre-existing wells were found to be completely dry or to have less than two feet of water, and could not be developed. These wells include:

- ✓ 105
- ✓ 47WW03
- ✓ 47WW04
- ✓ 47WW05
- ✓ 47WW12
- ✓ 47WW27
- ✓ 47WW28
- ✓ LHSMW40
- ✓ LHSMW47
- ✓ LHSMW49

- ✓ 47WW16
- ✓ 47WW18
- ✓ 47WW22
- ✓ LHSMW50
- ✓ LHSMW61

In total, 19 pre-existing wells were found to be dry, had less than two feet of water, or did not recharge, and therefore could not be developed.

Development was accomplished by pumping the wells with a low-flow submersible pump. Each well was surged multiple times with a large bailer to clear sediment from the well. Water levels were continuously monitored for each well and pumping rates were adjusted as needed to maintain flow. The development team also monitored water quality parameters during the entire development process. Water quality parameters were monitored until successive readings for temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation reduction potential were stable and within required ranges. A minimum of three well volumes of water were removed during development of each well. The development pump was placed mid-screen during development activities.

Development and decontamination water were drummed at each well location. The drums were labeled and left at the respective well location. Well development forms are included in **Appendix C**.

2.8 Phase I Monitoring Well Sampling

Twenty-five wells were sampled using low-flow sampling techniques, which entailed use of a small bladder pump to maintain a flow rate of 100 to 300 milliliters per minute to evacuate groundwater from the well. During pumping, water quality parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation reduction potential) and the water level were monitored until they stabilized. Once stabilization was achieved, sample bottles were filled. Pumping rates and volume of purge water produced were logged during sampling. Purge water was drummed and staged at the well location until final disposition at the LHAAP groundwater treatment plant (GWTP).

Dependent on historical site data, wells were sampled for a combination of perchlorate, metals, VOCs, SVOCs, and explosives. Specific analyses conducted for each monitoring well were determined based on the specific well's location and accompanying historical site data.

Samples were submitted to Microbac Laboratory, a Texas-licensed laboratory located in Marietta, Ohio, for chemical analyses. Field duplicate samples were collected for approximately every 10 samples collected for each analysis. Matrix spike and matrix spike duplicate samples were collected during the sampling activities for approximately every 20 samples collected for each analysis.

As part of quality control/quality assurance procedures utilized during the field investigation, field quality control samples were obtained during sampling activities. The quality control samples included equipment blanks, trip blanks, and temperature blanks. To assess the adequacy of equipment decontamination procedures, an equipment rinsate blank was collected during sampling activities and submitted for laboratory analysis. The equipment blank was collected by pouring laboratory-grade deionized water over decontaminated field sampling equipment and collecting the rinsate in sample containers. The equipment blank was analyzed for the same parameters as the groundwater samples.

For each cooler containing VOC samples, a trip blank was included. The trip blank consisted of two laboratory-provided, 40-milliliter vials containing deionized water. The trip blank was used to determine whether the sample shipment may have been contaminated during transit from the field to the laboratory. Trip blanks were analyzed for VOCs only.

A temperature blank was included in each cooler shipped to the laboratory. The temperature blank consisted of a small, laboratory-provided container containing water. It was used by the laboratory to confirm that the cooler arrived at the appropriate temperature.

The Phase I sampling effort began on July 19, 2018, and was completed on July 22, 2018. Well sampling forms are included in **Appendix D**.

2.9 Phase II Monitoring Well Installation

The Phase II monitoring well installation began on August 1, 2018, and finished on August 28, 2018. During this effort, an additional eight upper Intermediate Zone wells were installed.

Six of the wells (47WW40, 41, 42, 43, 45, and 47) were installed at previously drilled soil boring locations (SB-03, 04, 05, 06, 07i and, 08i, respectively), based on analytical results from the boring groundwater data, while two wells were installed at new locations (47WW44 and 47WW46). Phase II well locations are shown on **Figures 5** and **6**.

Upper Intermediate Zone wells were installed in the same manner as upper Intermediate Zone Phase I wells. Each well was completed to a maximum depth of 40 feet bgs. Wells were drilled with HSA and completed with 4-inch I.D. PVC casing and screen. Screens with 0.010-inch slots and 10 feet in length were installed at the bottom of each well. A 20/40 sieve silica sand pack was placed from the well terminus to a few feet above top of screen. Then a 2-foot minimum bentonite seal (3/8-inch pellets) was added on top of the sand pack and the remaining boring annulus was grouted to surface.

All Intermediate Zone wells installed were double-cased to prevent potential downward migration of contamination from the Shallow Zone. 47WW44, 45, 46, and 47 were surface-cased to 33, 21, 25, and 23 feet bgs, respectively. Surface casing was installed, grouted to surface, and left to cure for at least 24 hours prior to drilling to final depth.

Intermediate Zone wells were completed to a maximum depth of 65 feet bgs. Wells were drilled using a mud rotary method because of the challenging geologic conditions (flowing sands) encountered in the upper Intermediate Zone. Wells were completed with 4-inch I.D. PVC casing and screen. Screens with 0.010-inch slots and 10 feet in length were installed at the bottom of each well. A 20/40 sieve silica sand pack was placed from the well terminus to a few feet above top of screen. Then a 2-foot minimum bentonite seal was added on top of the sand pack and the remaining boring annulus was grouted to surface. Well completion details can be referenced above, in the Phase I well installation summary.

Although mud rotary method was employed, borehole collapse was a recurring issue. For example, 47WW45 had 18 feet of collapse. This location also proved difficult for DPT, as the sands kept locking the acetate sample tube in the macro-core sampler. Wells 47WW46 and 47WW47 had to be drilled twice before casing could be installed properly.

Soil cuttings and decontamination fluids were drummed (separately) and left at the respective well location. Drums were labeled to document their contents and associated well location. Boring logs and well completion forms for Phase II wells are included in **Appendix A** and **Appendix B**, respectively.

2.10 Phase II Monitoring Well Development

Phase II well development was initiated during the final portion of the Phase II well installation, beginning on August 21, 2018, and finishing on September 7, 2018.

Well development was performed for all eight Phase II installed monitoring wells, plus three pre-existing, historical monitoring wells (47WW09, 47WW37, and 47WW38). A second attempt was made to develop wells 47WW13 and 47WW21, but both still had no recharge, similar to Phase I.

Development was accomplished using the same processes described for Phase I development.

Development and decontamination water were drummed at each well location. The drums were labeled and left at the respective well location. Well development forms are included in **Appendix C**.

2.11 Water Level Measurements

Following the Phase II development activities, and prior to Phase II sampling activities, water level measurements were collected. On September 15, 2018, groundwater elevation data was recorded for 47 monitoring wells at the site. Three wells were recorded as dry during the water level measurements, while nine additional wells were recorded as dry during development activities. Wells listed in **Section 2.2** were also noted as dry, many of which were replaced with deeper monitoring wells. **Figure 3** displays the wells that were noted as dry.

In all, groundwater elevations were obtained for 44 site wells. Water level data for all wells checked during the PSI is presented in **Table 2**. Groundwater elevation contour maps are presented in **Figure 3** and **Figure 4**.

2.12 Phase II Monitoring Well Sampling

Following Phase II development activities, groundwater sampling was conducted for all wells that were developed during Phase II (11 total wells).

Wells were sampled for a combination of perchlorate, metals, VOCs, SVOCs, and explosives. Specific analyses for each well were determined based on the well's location and accompanying historical site data.

Sampling was performed using the same processes described for Phase I sampling.

The Phase II sampling effort began on September 16, 2018, and finished on September 18, 2018. Well sampling forms are included in **Appendix D**.

2.13 Investigation-derived Waste Disposal and Cleanup Activities

Site cleanup and waste disposal activities were conducted September 10, 2018, through September 18, 2018.

A composite toxicity characteristic leaching procedure (TCLP) soil sample was collected prior to waste disposal. The TCLP analyses included toxicity analyses for VOCs, SVOCs, metals (including mercury), herbicides, pesticides, plus analyses for ignitability, corrosivity, and reactivity. The results indicated that the soil cuttings from the drilling activities were non-hazardous. Once determined non-hazardous, the drilling contractor mobilized a Bobcat mini track loader to the site, which was used to turn the drums over and empty them at their respective drilling locations. Once soil was dumped from the drums, it was spread evenly across the drilling area ground surface. Empty drums were then transported to a centralized location within the laydown yard.

Drums containing fluids from decontamination and sampling activities were loaded and transported by trailer to the GWTP, where they were emptied into the treatment sump in accordance with the approved IWWP and PSI WP. Prior to disposal, the GWTP plant manager was contacted to gain approval to dispose of the LHAAP-47 wastewater at the sump location. After emptying water drums, they were transported to the laydown area and staged adjacent to the empty soil drums.

Once all drums were staged, a local recycling facility was contacted to pick them up for salvage. A total of 205 drums were recycled.

After the drums were addressed, each drilling location was policed for trash and housekeeping. Each well was inspected for final completion (pad, bollards, protective cover, and paint), locks were added, and each well was labeled.

Finally, the driller was instructed to remove all job materials from the laydown area.

2.14 Well Survey

The final task during the PSI effort was the well survey. All new wells were surveyed by a local Texas-licensed surveyor. Survey activities were performed September 20, 2018, through September 25, 2018.

3 Investigation Findings

This section presents sample results from the PSI field investigation. The groundwater results presented in this section have been compared to Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs), where they exist. Where an MCL has not been promulgated, the Texas Risk Reduction Program (TRRP) Protective Concentration Levels (PCL) Tier 1 residential groundwater ($^{GW}GW_{Ing}$) (TRRP PCL) are the comparison levels. Monitoring well results are discussed in relation to these screening levels. An analytical results summary for the monitoring well samples is presented below.

3.1 Lithology

LHAAP has undergone numerous investigations, including at the LHAAP-47 site area, to gather data on subsurface geology and contamination.

The prevailing conceptual site model for the LHAAP subsurface describes the presence of shallow, intermediate, and deep water-bearing units, with the two upper water-bearing units (Shallow Zone and Intermediate Zone) separated across most of the site by a contiguous, clay aquitard. The aquitard is generally encountered approximately 20 feet bgs, with the clay being 1-2 feet thick in most locations, then the upper Intermediate to the termination depth of the PSI drilling efforts.

The PSI effort included installation of 11 soil borings and 18 monitoring wells. Although some of the borings and wells were co-located, a significant amount of drilling was completed at multiple discrete locations across the site.

In general, drilling activities found the clay aquitard between the Shallow Zone and Intermediate Zone to be encountered at various depths and in varying thicknesses. The aquitard is thin (e.g., 1-2 feet) in many locations and not present at others. The clay thickness varies from 1-15 feet. Based on the findings of the DPT and well boring activities, it is debatable whether the aquitard is contiguous across LHAAP-47 or that it prevents downward migration of groundwater. The presence of perched water was also suspected at several locations in the Shallow Zone due to an uneven surface. In general, these perched water zones were found between the ground surface and 20 feet bgs, and were comprised of very thin (less than 2-inches in thickness) layers of coarse sand.

All borings completed in the Shallow Zone were dry and had to be advanced to the upper Intermediate Zone to find water. All wells installed during the PSI were completed in the Intermediate Zone, including the upper intermediate zone where the replacement wells intended for the Shallow Zone were installed no deeper than 40 feet. Shallow Zone replacement wells were denoted with an “R” appended to the original well name, to designate it as a replacement for a dry Shallow Zone well. However, these replacement wells extended into the upper Intermediate Zone sand.

3.2 Boring Results

As described in **Section 2**, eleven soil borings were completed during the PSI field investigation. Soil borings were completed to obtain analytical data for groundwater contaminant levels, with the ultimate goal of using the data to identify the spatial extent of contamination and to support the selection of locations for installation of new, permanent monitoring wells (i.e., re-asses and update groundwater data at the site).

Sixteen total groundwater samples were collected from the borings. Two duplicate samples were also collected. All samples were analyzed for perchlorate and VOCs. Sample results for the soil borings are presented in **Table 1**. Locations of the soil borings are presented in **Figures 5** and **6**.

Perchlorate was detected in five samples. Boring locations SB-03 and SB-08i had detections in both shallow and deep samples. Boring SB-11i had a detection (0.271 micrograms per liter [µg/L]) in the deep sample collected. All detections were well below the TRRP PCL of 17 µg/L. Detected values ranged from 0.214 µg/L (SB-03 shallow sample) to 6.12 µg/L (SB-08i shallow sample). Permanent monitoring wells 47WW40 and 47WW47 were installed at SB-03 and SB-08i, respectively.

Acetone was the most commonly detected VOC in the samples (detected values ranged from 2.68 to 48.7 µg/L), but the highest value of 48.7 µg/L was far below the TRRP PCL of 22,000 µg/L. Acetone results in SB-07iA and SB-08iA were qualified as estimated, with possible low bias (J-) due to headspace in the sample vials. It is suspected that most of the acetone detections are an artifact caused by contamination during sample transportation, as no laboratory blanks had acetone detections while several trip blanks did have acetone detections. Acetone results in SB-03A, SB-03B, SB-04A and SB-05B were qualified as estimated, with possible high bias (J+), due to acetone detections in the associated trip blanks.

The VOCs 1,1-DCE (detected values ranged from 6.97 to 70.8 µg/L) and TCE (detected values ranged from 0.481 to 8,420 µg/L) had the most detections above PCLs/MCLs of any VOCs. The VOC 1,1-DCE exceeded the MCL of 7 µg/L in three samples, including SB-05A and SB-05B (i.e., shallow and deep samples) and SB-07iB (deep sample). TCE exceeded the MCL of 5 µg/L in five samples, including SB-05A and SB-05B, SB-06A, and SB-07iA and SB-07iB.

The remaining VOC detections that exceeded PCLs/MCLs were all found in the SB-05 samples. In addition to 1,1-DCE and TCE exceedances, the VOCs 1,2-dichloroethane (1,2-DCA) (two detections at 10.8 µg/L and 12.6 µg/L), cis-1,2-dichloroethene (cis-1,2-DCE) (detected values ranged from 0.322 to 16,200 µg/L), trans-1,2-DCE (two detections at 137 µg/L and 170 µg/L), and vinyl chloride (VC) (two detections at 2,400 µg/L and 3,420 µg/L) exceeded PCLs/MCLs. This is consistent with PID screening that was conducted during boring activities, with SB-05 and SB-07i being locations that produced high readings.

Chloroform was the only VOC not detected in any of the boring samples.

Based on the boring groundwater sample results, permanent monitoring wells were installed at soil boring locations SB-03 (47WW40), SB-04 (47WW41), SB-05 (47WW42), SB-06 (47WW43), SB-07i (47WW45), and SB-08i (47WW47).

Analytical results for the borings are presented in **Table 1**, while the boring locations are presented in **Figures 5** and **6**. The raw analytical data packages for the boring samples are presented in **Appendix E**.

3.3 Monitoring Well Results

Thirty-six monitoring wells were sampled during the PSI field investigation, including 18 newly installed wells and 18 historical wells.

Wells were sampled for a combination of perchlorate, metals, VOCs, SVOCs, and explosives. For LHAAP, separate lists of COCs have been identified for shallow versus intermediate zone

groundwater. Therefore, based on groundwater zone and specific site location, not all wells were sampled for all analytes. Comprehensive analytical results for groundwater monitoring well samples are presented in **Table 3**. Analytical results summary statistics for groundwater monitoring well samples are presented in **Table 4**. The raw analytical data packages are presented in **Appendix G**, while the data validation reports are presented in **Appendix F**.

Perchlorate

Samples were collected from 21 wells for perchlorate analysis.

Perchlorate was detected in samples from seven wells at concentrations ranging from 0.107 µg/L at LHSMW55R to 38,400 µg/L at LHSMW60 (duplicate sample [parent sample was 33,000 µg/L]). The TRRP PCL of 17 µg/L for perchlorate was exceeded in samples from four wells (47WW11R, 47WW38, LHSMW43R, and LHSMW60).

Metals

Samples were collected from 10 wells for metals analysis.

Aluminum was detected in samples from two wells, 47WW06 and LHSMW46R, at concentrations of 0.194 milligrams per liter (mg/L) and 0.139 mg/L, respectively. Neither result exceeded the aluminum TRRP PCL of 24 mg/L.

Chromium was detected in samples from five wells (47WW06, 47WW14, 47WW19, 47WW37, and LHSMW60), at concentrations ranging from 0.0112 mg/L at 47WW37 to 0.131 mg/L at 47WW14. The only detected concentration to exceed the chromium MCL of 0.1 mg/L was observed at well 47WW14. 47WW14 has a stainless steel screen, which is a potential source of chromium at this location.

Cobalt was detected in the sample from one well, 47WW06, at a concentration of 0.0115 mg/L. The detected result is below the TRRP PCL of 0.24 mg/L.

Manganese was detected in samples from nine wells, at concentrations ranging from 0.0328 mg/L in 47WW37 to 1.37 mg/L in well 47WW19. Although the manganese TRRP PCL of 1.1 mg/L was exceeded only at well 47WW19, the site background for manganese is 7.82 mg/L (Shaw 2007c).

Nickel was detected in samples from five wells, at concentrations ranging from 0.0214 mg/L at 47WW19 to 0.529 mg/L at 47WW09. The nickel TRRP PCL of 0.49 mg/L was exceeded only at 47WW09.

Strontium was detected in samples from nine wells, at concentrations ranging from 0.383 mg/L in LHSMW46R to 3.78 mg/L in well 47WW08R. The strontium TRRP PCL of 15 mg/L was not exceeded.

Tin was detected in the sample from one well, 47WW41, at a concentration of 0.439 mg/L. The detected result is below the tin TRRP PCL of 15 mg/L.

Arsenic was detected in samples from nine wells, at concentrations ranging from 0.00168 mg/L at 47WW14 to 0.0262 mg/L at 47WW06. The arsenic MCL of 0.01 mg/L was exceeded only at 47WW06.

Thallium was detected in the sample from one well, 47WW06, at a concentration of 0.000112 mg/L. The detected result is below the thallium MCL of 0.002 mg/L.

Silver, vanadium, antimony, and cadmium had no detections above the method detection limit.

VOCs

Samples were collected from 31 wells for VOC analysis.

1,1-DCE was detected in samples from 13 wells, with concentrations ranging from 0.560 µg/L at LHSMW41 to 176 µg/L at LHSMW56R. Six detections exceeded the 1,1-DCE MCL of 7 µg/L.

1,2-DCA was detected in samples from four wells. The detected concentrations of 0.283 µg/L, 0.310 µg/L, 0.486 µg/L, and 4.18 µg/L at wells 47WW09, 47WW25R, 47WW34, and 47WW42, respectively, were all below the 1,2-DCA MCL of 5 µg/L.

Acetone was detected in samples from 10 wells, with concentrations ranging from 2.59 µg/L at 47WW43 to 12.1 µg/L at 47WW33. None of the detections exceeded the acetone TRRP PCL of 22,000 µg/L. Acetone results in nine samples were qualified estimated with possible high bias (J+) due to acetone detections in the associated trip blanks. Acetone detections are likely due to contamination during transportation.

Chloroform was detected in samples from one well, 47WW25R, at a concentration of 1.16 µg/L, which was well below the MCL of 80 µg/L.

cis-1,2-DCE was detected in samples from 21 wells, with concentrations ranging from 0.304 µg/L at 47WW33 to 5,260 µg/L at 47WW42. Eight detections exceeded the cis-1,2-DCE MCL of 70 µg/L.

Tetrachloroethene (PCE) was detected in samples from three wells, at concentrations of 9.99 µg/L, 0.840 µg/L, and 0.763 µg/L at wells 47WW09, 47WW25R, and LHSMW56R, respectively. Only the detection at 47WW09 exceeded the PCE MCL of 5 µg/L.

trans-1,2-DCE was detected in samples from 12 wells, at concentrations ranging from 0.271 µg/L at 47WW45 (duplicate sample) to 56.5 µg/L at 47WW42. None of the detections exceeded the trans-1,2-DCE MCL of 100 µg/L.

TCE was detected in samples from 27 wells, at concentrations ranging from 0.271 µg/L at LHSMW55R to 120,000 µg/L at 47WW25R. Eighteen of the detections exceeded the TCE MCL of 5 µg/L.

VC was detected in samples from 13 wells, at concentrations ranging from 0.253 µg/L at 47WW37 to 1,190 µg/L at 47WW42. Eight of the detections exceeded the VC MCL of 2 µg/L.

SVOCs

Seven samples were collected for SVOC analysis.

bis(2-Ethylhexyl)phthalate (BEHP) was not detected in samples from any of the seven wells.

Herbicides

Seven samples were collected for herbicide analysis. Pentachlorophenol (PCP) was analyzed by the herbicide method SW8151A, rather than the SVOC method 8270C, in order to achieve a limit of quantitation (LOQ) below the MCL.

Samples from two wells, 47WW09 and LHSMW46R, had PCP detections of 46.1 µg/L and 17 µg/L, respectively. Both detections exceeded the pentachlorophenol MCL of 1 µg/L.

Explosives

Seven samples were collected from wells for explosive analyses.

The explosives 2,4,6-trinitrotoluene (2,4,6-TNT), 2,4-dinitrotoluene (2,4-DNT), and 2,6-dinitrotoluene (2,6-DNT) were not detected in any of the samples collected. Based on these results, it was determined that development/purge water generated could be discharged and treated at the GWTP.

3.4 Contaminant Distribution in Groundwater

Plumes for TCE, perchlorate, PCE, 1,1-DCE, cis-1,2-DCE, and VC are presented for the Shallow Zone and Intermediate Zone in **Figures 7** and **8**. Plumes were generated by drawing a plume boundary/contour around all results that exceeded applicable PCLs/MCLs for each contaminant. Specifically, plumes were not contoured at various concentration levels for each contaminant, but rather a plume boundary was drawn around all results that exceeded the comparison criterion for a particular contaminant.

TCE and perchlorate are the contaminants of greatest concern at LHAAP-47, and were subsequently included in the plume maps. PCE, 1,1-DCE, cis-1,2-DCE, and VC were also mapped because of their parent/daughter chemical anaerobic reduction relationship to TCE (PCE-TCE-DCE-VC).

Perchlorate

For the 21 wells sampled for perchlorate, only four results exceeded the comparison level of 17 µg/L. As shown in **Figure 8**, once plotted, these results indicate two small plumes in the Intermediate Zone.

Intermediate Zone

The Intermediate Zone perchlorate plumes are located at the eastern and southern edges of the site. The eastern plume is defined by 47WW11R (824 µg/L) and LHSMW43R (59 µg/L). This plume is bounded to the north by LHSMW42R (non-detect), the east by newly installed 47WW39 (non-detect), the west by LHSMW46R (non-detect), and south by 47WW43 (non-detect).

The southern perchlorate plume is defined by LHSMW60 (38,400 µg/L [duplicate sample; parent sample was 33,000 µg/L]) and 47WW38 (266 µg/L). This plume is bounded to the east by 47WW40 (non-detect), north by soil boring SB-10i (no water) and well 47WW26R (0.823 µg/L), west by soil boring SB-09i (non-detect, sample 046SB09iA), and south by 50WW27, which is a well associated with site LHAAP-50, which lies south of LHAAP-47. This plume is also bound by Goose Prairie Creek, and separate from the LHAAP-50 plume, as evidenced by 50WW27 data.

Metals

For the 10 wells sampled for metals, only four results exceeded TRRP PCLs/MCLs: arsenic at 47WW06 (0.0262 mg/L), nickel at 47WW09 (0.529 mg/L), chromium at 47WW14 (0.131 mg/L), and manganese at 47WW19 (1.37 mg/L). All results are from Intermediate Zone wells and only slightly exceed their respective PCLs/MCLs of 0.01 mg/L, 0.49 mg/L, 0.1 mg/L, and 1.1 mg/L. Wells with detections above the TRRP PCLs/MCLs are all located in the eastern-central portion of the site.

It should be noted that although manganese exceeded its PCL in one well, all results were below the site background of 7.82 mg/L for manganese.

Plume maps were not generated for metals.

VOCs

VOCs were analyzed at most well locations (31 of 36 sampled wells) and comprise the majority of detections in the data, including detections exceeding PCLs/MCLs.

The remaining VOCs (1,1-DCA, acetone, chloroform, and trans-1,2-DCE) had fewer detections and do not appear to be pervasive across the site area. All 1,1-DCA detections were less than the MCL. Acetone had multiple detections, but all were well below the TRRP PCL. Chloroform was detected in one well below the MCL. trans-1,2-DCE detections were all less than the MCL. As such, plume maps were not prepared for these compounds.

PCE

PCE was not detected above its MCL in the Shallow Zone and only once in the Intermediate Zone. As shown in **Figure 8**, the PCE concentration in well 47WW09 exceeded the MCL of 5 µg/L.

This PCE exceedance is bounded to the south, east, west, and north by wells 47WW43, 47WW39, LHSMW46R, and LHSMW42R, respectively (all non-detects).

TCE

As shown in **Figures 7** and **8**, TCE exceedances are present as a spot plume in the central portion of the site for the Shallow Zone and as a large plume throughout the central portion of the site for the Intermediate Zone. The Intermediate Zone plume also extends west of the site area.

Shallow Zone

For Shallow Zone TCE results, a small plume is present encompassing wells LHSMW44 and LHSMW45. Surrounding Shallow Zone wells to the north, south, east, and west are dry.

Intermediate Zone

For Intermediate Zone TCE results, exceedances dominate the central portion of the site, with a lobe that travels offsite in the southeastern corner. This lobe's easternmost extent is defined by 47WW34 (1,710 µg/L) and 47WW45 (1,910 µg/L [duplicate sample]). These results are bounded to the south, east, and north by newly installed wells 47WW47 (2.25 µg/L), 47WW44 (3.51 µg/L) and 47WW46 (2.29 µg/L), and 47WW29 (non-detect) respectively.

A TCE spot plume is present at well 47WW32 (43.5 µg/L), which is bounded to the east by 47WW33 (1.36 µg/L), west by 47WW31 (1.10 µg/L), and the south by newly installed 47WW39 (non-detect).

The western edge of the southeastern TCE plume lobe is defined by results at LHSMW56R (7,360 µg/L) and 47WW42 (2,660 µg/L), which are bounded by 47WW23 (1.38 µg/L) to the south and LHSMW55R (0.271 µg/L) to the west.

The western, most upgradient lobe of the plume is defined by 47WW25R (120,000 µg/L) and 47WW37 (151 µg/L). The 47WW25R result is bounded to the west by results at SB-01 and SB-02, both of which were non-detects for TCE. As this is the farthest upgradient location, the TCE plume originates from this location and travels eastward across the site area. The northern edge of the plume, as it expands from 47WW25R, is bounded on the north by newly installed 47WW08R (non-detect), south by wells LHSMW60 (non-detect) and LHSMW55R (0.271 µg/L), and east by wells 47WW39 (non-detect) and 47WW29 (non-detect). The 47WW25R TCE concentration is the highest detection at the site.

cis-1,2-DCE

As shown in **Figures 7** and **8**, cis-1,2-DCE results show less extensive contamination, as compared to TCE.

Shallow Zone

For the Shallow Zone, a spot plume is present at well LHSMW45 (690 µg/L). Surrounding Shallow Zone wells to the north, south, east, and west are dry.

Intermediate Zone

For the Intermediate Zone, a small west-east trending cis-1,2-DCE plume is present in the west-central portion of the site. The westernmost extent is defined by 47WW25R (2,550 µg/L), while the easternmost extent is defined by 47WW14 (124 µg/L). The eastern and southern edges of this plume are bounded by LHSMW46R (25.8 µg/L) and SB-02 (non-detect), the north by 47WW37 (11.1 µg/L), and the west by SB-01 (non-detect).

A second cis-1.2-DCE plume is present in the southeastern corner of the site. It is defined by LHSMW56R (95.9 µg/L), 47WW42 (5,260 µg/L), and 47WW34 (167 µg/L). This plume is bounded to the north by 47WW19 (non-detect), west by LHSMW55R (non-detect), south by 47WW23 (non-detect), and east by wells 47WW45 (15.2 µg/L) and 47WW47 (0.398 µg/L).

Another cis-1,2-DCE spot plume is present at 47WW09 (103 µg/L) and LHSMW43R (74.1 µg/L). This plume is bounded to its west, north, south, and east by LHSMW46R (25.8 µg/L), LHSMW41 (2.89 µg/L), 47WW43 (0.917 µg/L), and 47WW39 (non-detect), respectively.

1,1-DCE

1,1-DCE was detected above its MCL in six wells in the Intermediate Zone.

1,1-DCE did not exceed its MCL in the Shallow Zone. For the Intermediate Zone, 1,1-DCE plumes mimic the footprints described for cis-1,2-DCE.

A 1,1-DCE spot plume is present at 47WW25R (20.8 µg/L), which is bounded on its north, south, east, and west by 47WW37 (non-detect), SB-02 (non-detect), 47WW14 (3.39 µg/L), and SB-01 (non-detect), respectively.

Another 1,1-DCE spot plume is present at 47WW09 (19.6 µg/L), which is bounded to its west, north, south, and east by LHSMW46R (1.47 µg/L), LHSMW41 (0.560 µg/L), 47WW43 (non-detect), and 47WW39 (non-detect), respectively.

Finally, a 1,1-DCE plume is present in the southeastern corner of the site, extending out of the site boundary. This plume is defined by LHSMW56R (176 µg/L), 47WW42 (29.6 µg/L), 47WW45 (7.26 µg/L), and 47WW34 (8.33 µg/L). This plume is bounded to the north by 47WW19 (non-detect), west by LHSMW55R (non-detect), south by 47WW23 (non-detect), and east by wells 47WW44 (non-detect) and 47WW46 (non-detect).

VC

Shallow Zone

For the Shallow Zone, a VC spot plume is present at well LHSMW45 (32.6 µg/L). Surrounding Shallow Zone wells to the north, south, east, and west are dry.

Intermediate Zone

For the Intermediate Zone, a southwest-northeast trending VC plume is present in the central portion of the site. The westernmost extent is defined by 47WW25R (86.3 µg/L), while the easternmost extent is defined by LHSMW43R (2.37 µg/L). The north, south, east, and west edges of this plume are bounded by 47WW37 (0.253 µg/L) and LHSMW41 (non-detect), LHSMW46R (1.11 µg/L), 47WW39 (non-detect), and SB-01 (non-detect).

A second VC plume is present in the southeastern corner of the site. It is defined by LHSMW56R (6.23 µg/L), 47WW42 (1,190 µg/L), and 47WW34 (2.32 µg/L). This plume is bounded to the north by and 47WW19 (non-detect), west by LHSMW55R (non-detect), south by 47WW23 (non-detect), and east by wells 47WW45 (0.602 µg/L) and 47WW47 (non-detect).

SVOCs

Samples were analyzed for one SVOC, BEHP. There were no detections.

Plumes were not generated for SVOCs.

Herbicides

Samples were analyzed for one herbicide, PCP. Samples from two wells, 47WW09 and LHSMW46R, had PCP detections of 46.1 µg/L and 17 µg/L, respectively. Both detections exceeded the pentachlorophenol MCL of 1 µg/L.

Plumes were not generated for herbicides.

Explosives

Samples were analyzed for three explosives, 2,4,6-TNT, 2,4-DNT, and 2,6-DNT. No explosives were detected.

Plumes were not generated for explosives.

4 Conclusions

The LHAAP-47 PSI field investigation was performed to update the current condition of groundwater contamination. For historical groundwater data, including plume maps, the FS (Shaw 2011) should be referenced.

Through the installation and sampling of groundwater at multiple borings and monitoring wells, a current snapshot of subsurface contamination was developed for the site. Perchlorate, metals, VOCs, SVOCs, and explosives are considered COCs for the LHAAP-47 site and groundwater samples were analyzed for these contaminants. From historical data, perchlorate and VOCs are known to be the most prominent contaminants at the site.

Extent of Contamination

Although extensive contamination remains at the site, the spatial extent in the Shallow and Intermediate Zones has changed. As presented in Section 3.4, almost every contaminant plume boundary has been re-defined by a new or existing data point (i.e., groundwater results collected from a boring or well location). The majority of groundwater contamination now occurs within the Intermediate Zone.

A decline in water levels resulted in a large portion of the Shallow Zone going dry. As a result, the VOC extent is substantially reduced when compared to the 2010 results. This change is evident by comparison of **Figure 5** and **Figure 7**, showing the perchlorate plumes no longer exist and the VOC plume is much smaller. The extent of groundwater contamination in the Shallow Zone now consists of a single, small VOC plume in the vicinity of LHSMW44 and LHSMW45.

Due to the lack of groundwater in the Shallow Zone, replacement wells for dry Shallow Zone wells had to be completed in the upper Intermediate Zone. These replacement wells into the upper Intermediate Zone provide updated information on groundwater impacts underlying the clay layer between the Shallow and Intermediate Zones (as depicted in **Appendix H** cross-sections). Two separate VOC plumes depicted in 2010 (**Figure 6**) are presented as merged in Figure 8 as a result of analytical data obtained from replacement well 47WW11R. The eastward extent remains similar to that of 2010. The results of 47WW11R, along with LHSMW43R, also a replacement well, define the presence of an additional small perchlorate plume not present in the 2010 data.

The groundwater gradient in the Intermediate Zone has been verified to flow to the northeast toward Caddo Lake. The identified contaminant plumes reflect this in their orientation and shape.

Groundwater Contamination

In general, metals, SVOCs, herbicides, and explosives concentrations detected in groundwater did not indicate extensive contamination. While several metal compounds were detected above PCLs/MCLs, the detections were isolated and only slightly greater than corresponding TRRP PCLs/MCLs. Metals exceedances only occurred in the Intermediate Zone samples, while metal concentrations detected in the Shallow Zone were well below TRRP PCLs/MCLs. The metal results indicate that past site activities did not create extensive metals contamination at the site.

One SVOC was included in the sample analyses. BEHP was not detected at a concentration above the method detection limit or MCL. Similar to metals, SVOC contamination is isolated at the site.

One herbicide was included in the sample analyses. PCP exceeded its comparison level of 1 µg/L at two well locations, 47WW09 (46.1 µg/L) and LHSMW46R (17 µg/L). Similar to metals, herbicide contamination is isolated at the site.

Three explosives were included in the sample analyses. Of the samples tested, no explosives were detected in the groundwater. As such, explosives contamination is not a concern at LHAAP-47.

VOCs constitute most of the detections and exceedances in the groundwater data, consistent with historical site data. The most prevalent compounds were TCE and cis-1,2-DCE. As shown in the contaminant plume maps (**Figures 7** and **8**), there is VOC contamination in both the Shallow and Intermediate Zones at LHAAP-47. VOC contamination is very limited in the Shallow Zone, with a spot plume in the central portion of the site, surrounded by dry wells. VOC contamination is most extensive in the Intermediate Zone, blanketing the central portion of the site and extending offsite at the southeastern site boundary.

Perchlorate results reveal two small plumes in the Intermediate Zone (east-central and south).

Comparison with Previous Data

Shallow Zone

When comparing the PSI plume data to plume data presented in the FS (Shaw 2011), which represent sample data through 2010, the overall extent of contamination in the Shallow Zone is substantially reduced, driven primarily by a lack of groundwater in the Shallow Zone.

Intermediate Zone

When comparing the PSI plume data to plume data presented in the FS (Shaw 2011), which represent sample data through 2010, the overall extent of contamination in the Intermediate Zone is similar.

The extent of the TCE plume in 2010 and that observed in the PSI data are similar, with the main difference being the older data has the plume split into separate northern and southeastern plumes. The highest concentration was noted at 47WW25R (120,000 µg/L). Based on the results of the PSI sampling, the two historic plumes presented in the FS were combined. The rationale being results from the newly installed well 47WW43, which had elevated concentrations of TCE that indicate there is a single plume or that the previous plumes are now connected. Nevertheless, the plumes are located in the same areas and have the approximate same footprints.

Plumes for 1,1-DCE, cis-1,2-DCE, and VC are similar when the FS and PSI data are compared. Each of these contaminants show plumes in the west-central and the southeastern portions of LHAAP-47. The plume footprints are similar, whereas the concentrations are variable with respect to increasing or decreasing concentrations.

The extent of perchlorate groundwater contamination is also similar in that the plumes have not migrated, except the east-central perchlorate plume is shown in the Shallow Zone for the FS. This is due to the FS having Shallow Zone data for well 47WW11, whereas now 47WW11 is dry and its new replacement well, 47WW11R, is screened in the upper Intermediate Zone. The current perchlorate plumes are defined by wells screened in the Intermediate Zone. Due to the lack of groundwater in the Shallow Zone, perchlorate groundwater contamination is not present.

The FS did not present contaminant plumes for 1,1-DCE, cis-1,2-DCE, and VC in the Intermediate Zone. However, the FS did present a contaminant plume for PCE, which proved similar to data generated during the PSI (spot plume centered on 47WW09). In 2010, well 47WW09 had a PCE concentration of 9.08 µg/L, while the PSI data revealed a concentration of 9.99 µg/L. Many results for 1,1-DCE, cis-1,2-DCE, and VC show increasing concentrations from previous sample data to the PSI sample data.

Surface Water

Although surface water samples were planned for the PSI, weather conditions suitable to collect samples did not occur during the duration of field activities. Surface water samples will be collected at a later date, and the data will be presented as an addendum to this report.

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Attachment 1

Figures

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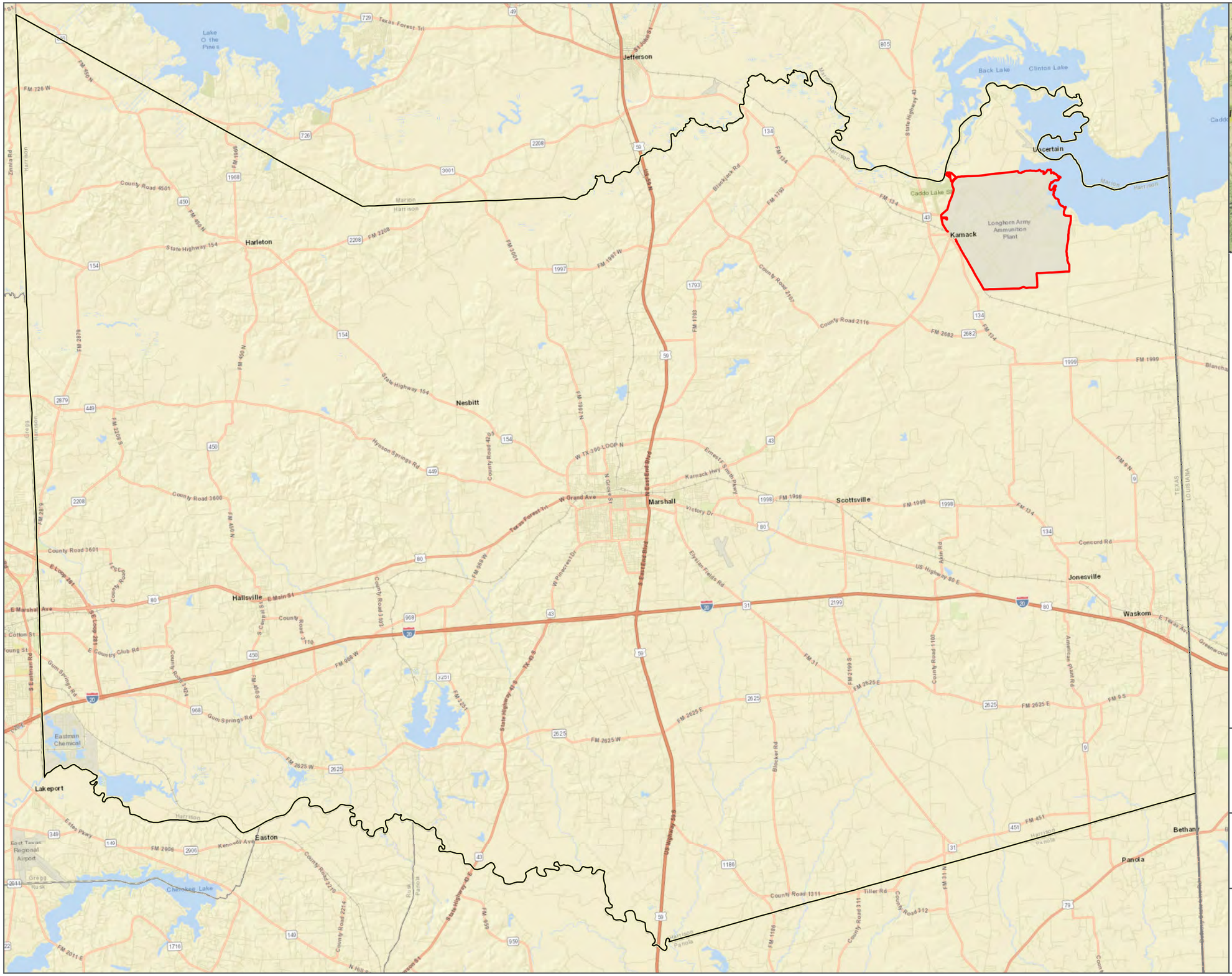

LEGEND

- LHAAP Installation Boundary
- Harrison County
- State Boundary

DATA SOURCES: ESRI

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

LHAAP-47 SITE LOCATION

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

N

0 3 6
MILES

FIGURE 1

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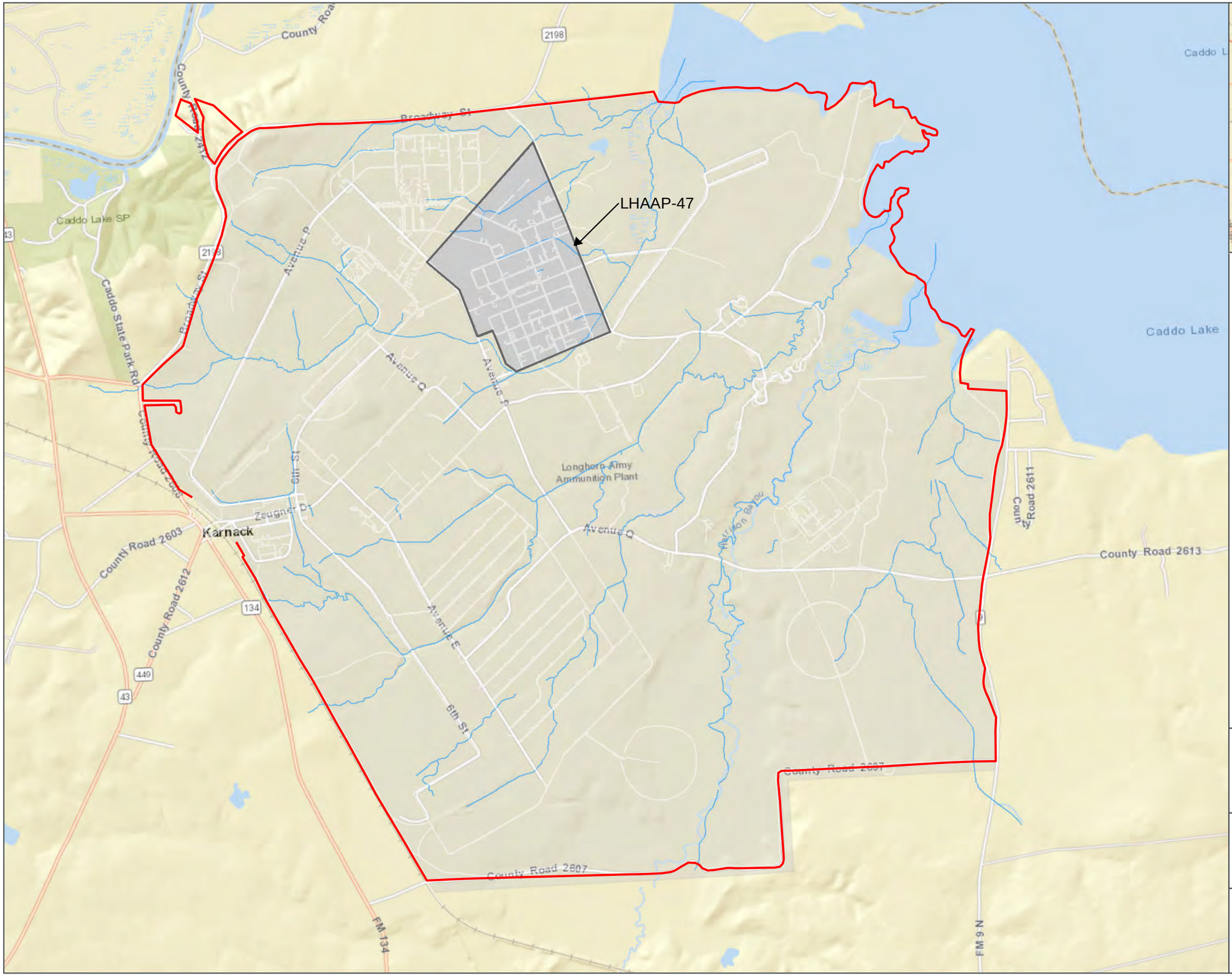

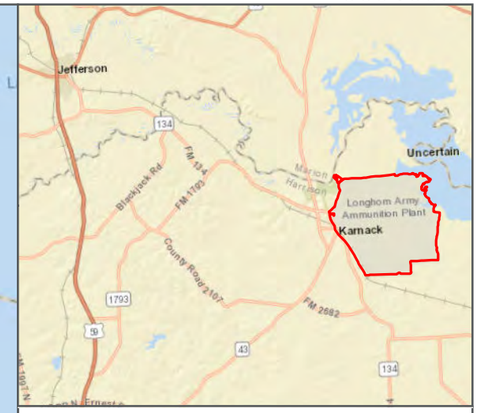

LEGEND

- LHAAP Installation Boundary
- Site
- Road
- Stream

DATA SOURCES: ESRI

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

LHAAP-47 SITE MAP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

N

0 0.5 1
MILES

ON THE LINE

FIGURE 2

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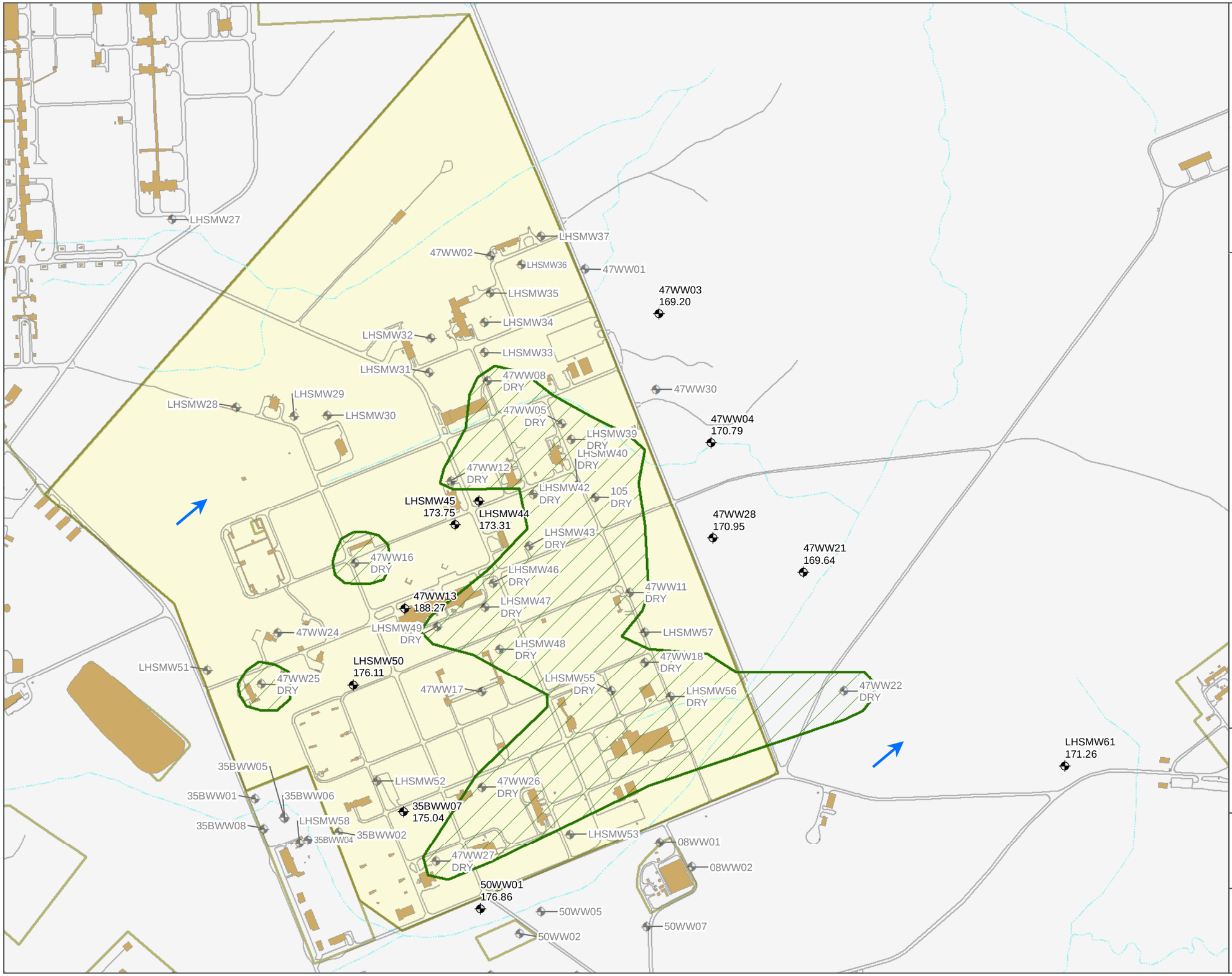

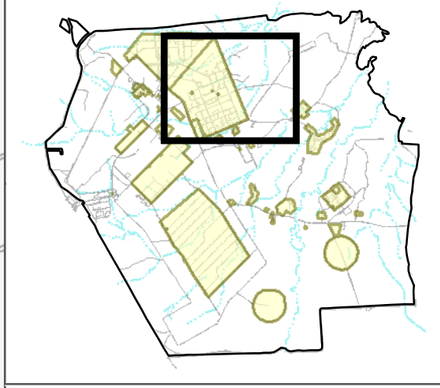

LEGEND

- Shallow Monitoring Well (Not Measured)
- Shallow Monitoring Well (with Groundwater Elevation)
- Dry Zone
- Road
- Stream
- Building
- LHAAP-47
- LHAAP Site

NOTES:
Due to a majority of shallow wells being dry, no groundwater elevation contours were created
Groundwater gradient indicated by arrow.

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

GROUNDWATER ELEVATION MAP
SHALLOW ZONE SEPTEMBER 2018

LHAAP-47
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

N

0 500 1,000
FEET

FIGURE 3

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00916052

LHSMW23
LHSMW26
LHSMW38
LHSMW08
47WW08R 166.92
47WW06 171.08
LHSMW42R 172.37
LHSMW41 172.75*
47WW09 173.32
LHSMW43R 172.80
47WW14 175.24
47WW43 170.89
LHSMW46R 173.61
47WW11R 172.39
47WW37 175.54
47WW25R 175.76
47WW19 173.24
LHSMW55R 173.43
LHSMW56R 172.88
47WW42 173.09
47WW41 173.42
47WW26R 170.77
LHSMW54 173.49
47WW40 174.53
47WW38 175.64
LHSMW60 175.99
35BWW03
50WW27
50WW06
47WW31 169.91
47WW32 169.10
47WW33 168.04
47WW35 168.30
47WW39 170.84
47WW29 171.98
47WW46 169.83
47WW36
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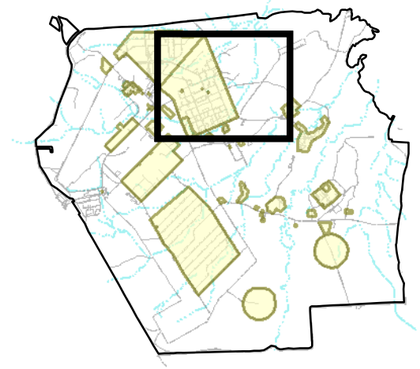

LEGEND

- Intermediate (Upper) Monitoring Well (Not Measured)
- Intermediate (Upper) Monitoring Well (with Groundwater Elevation)
- Intermediate Monitoring Well (Not Measured)
- Intermediate Monitoring Well (with Groundwater Elevation)
- Groundwater Elevation Contour
- Road
- Stream
- Building
- LHAAP-47
- LHAAP Site

NOTES:
* = July 2018 water level

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

GROUNDWATER ELEVATION MAP
INTERMEDIATE ZONE
SEPTEMBER 2018
LHAAP-47
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

N
0 500 1,000
FEET

FIGURE 4

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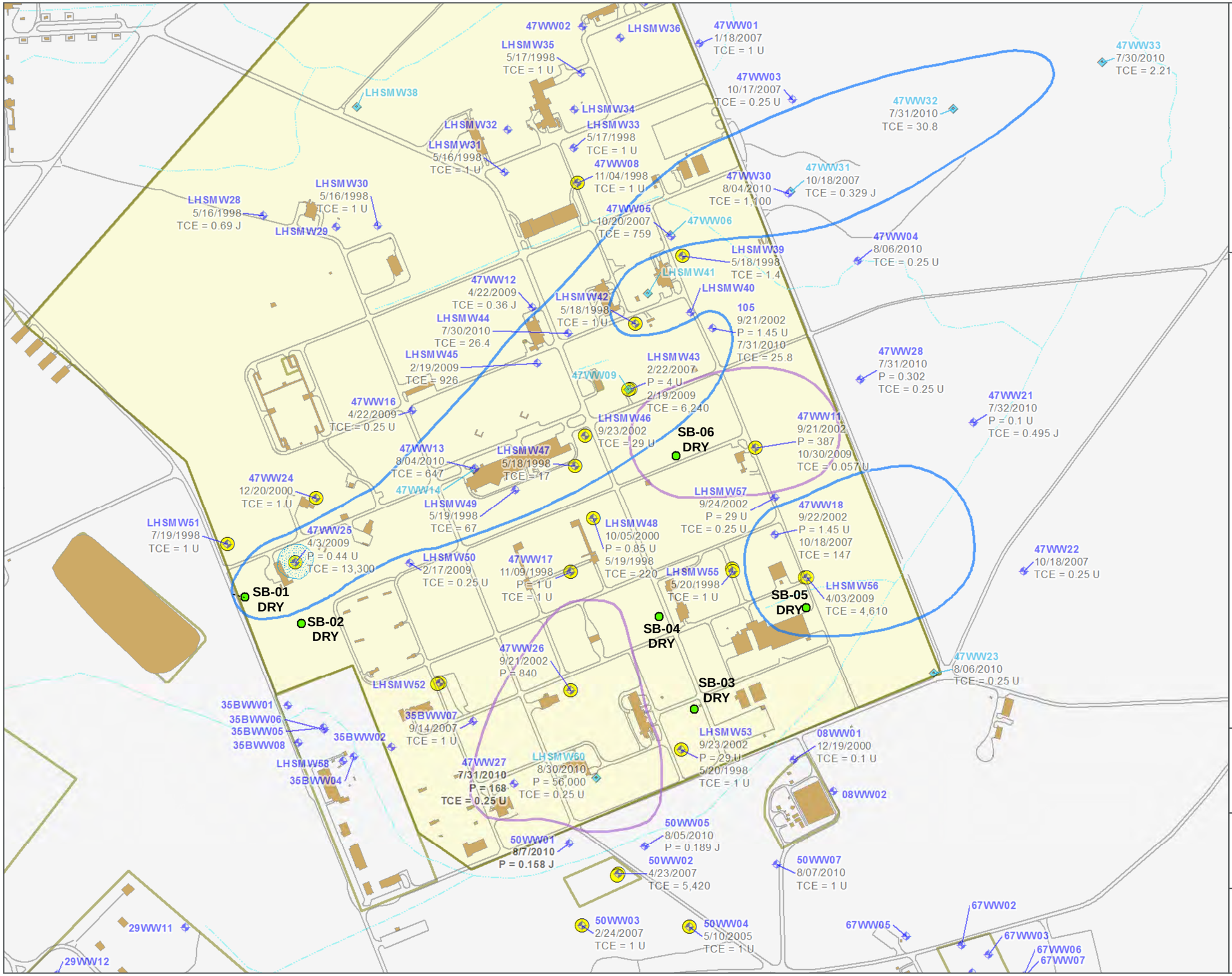

LEGEND

- Soil Boring Location, Sampled 2018
- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Well Dry in 2010
- Perchlorate Exceeding Shallow Zone TRRP PCL (17 µg/L), 2010 and prior
- Trichloroethene Exceeding Shallow Zone MCL (5 µg/L), 2010 and prior
- Hot Spot DPT Grid ISEB
- Road
- Stream
- Building
- LHAAP-47
- LHAAP Site

NOTE: Soil boring data blocks apply to groundwater grab samples. Map data and plume boundries apply to previous sampling results through 2010 .

GROUNDWATER GRAB SAMPLE RESULTS
SHALLOW ZONE
MAY 2018

LHAAP-47
LONGHORN ARMY AMMUNITION PLANT

N

0 500 1,000
FEET

FIGURE 5

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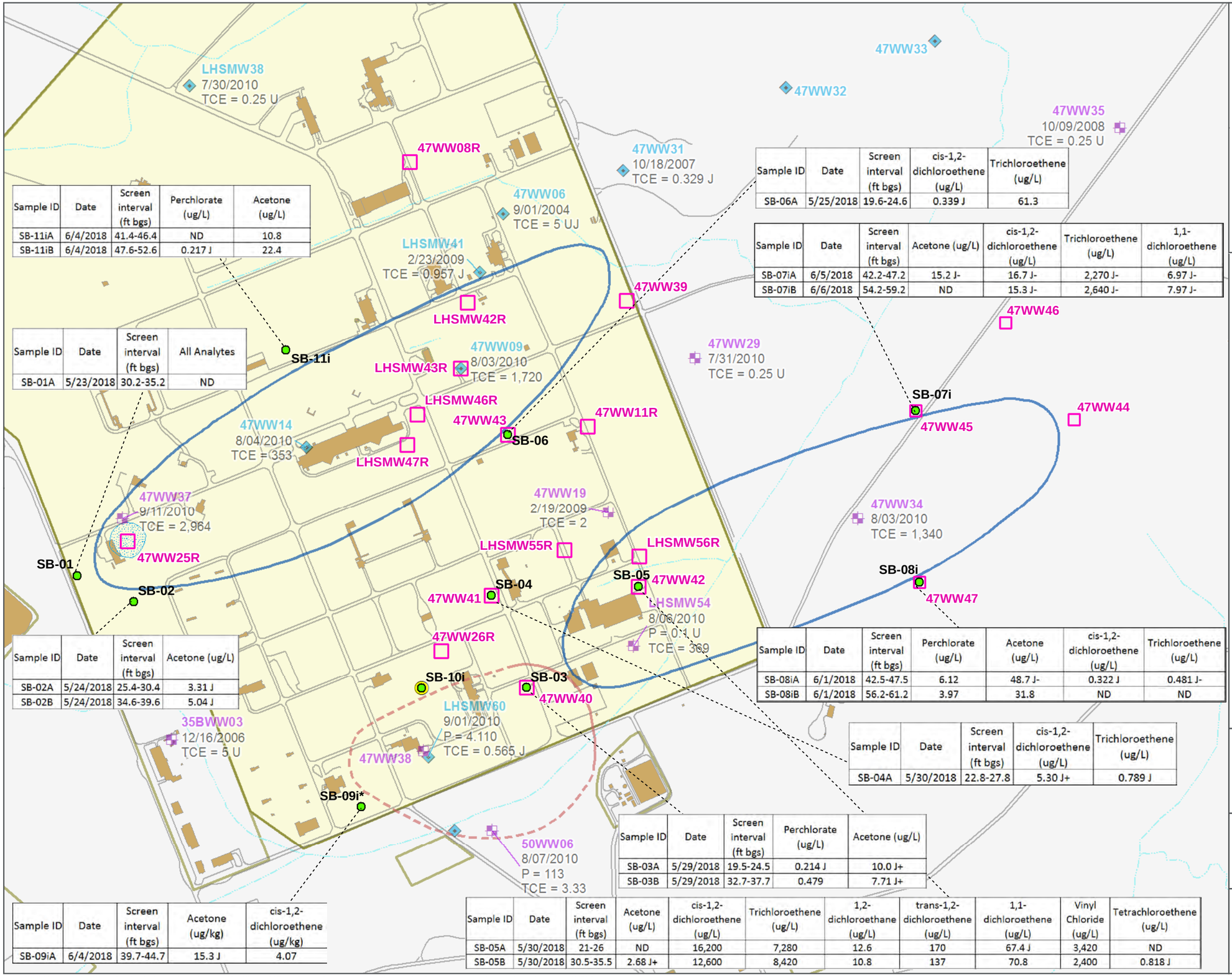


Sample ID	Date	Screen interval (ft bgs)	Perchlorate (ug/L)	Acetone (ug/L)
SB-11iA	6/4/2018	41.4-46.4	ND	10.8
SB-11iB	6/4/2018	47.6-52.6	0.217 J	22.4

Sample ID	Date	Screen interval (ft bgs)	All Analytes
SB-01A	5/23/2018	30.2-35.2	ND

Sample ID	Date	Screen interval (ft bgs)	Acetone (ug/L)
SB-02A	5/24/2018	25.4-30.4	3.31 J
SB-02B	5/24/2018	34.6-39.6	5.04 J

Sample ID	Date	Screen interval (ft bgs)	Acetone (ug/kg)	cis-1,2-dichloroethene (ug/kg)
SB-09iA	6/4/2018	39.7-44.7	15.3 J	4.07

Sample ID	Date	Screen interval (ft bgs)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)
SB-06A	5/25/2018	19.6-24.6	0.339 J	61.3

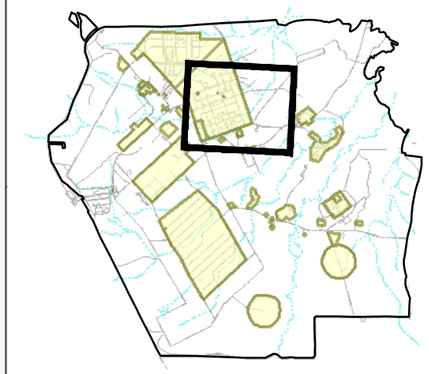
Sample ID	Date	Screen interval (ft bgs)	Acetone (ug/L)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)	1,1-dichloroethene (ug/L)
SB-07iA	6/5/2018	42.2-47.2	15.2 J-	16.7 J-	2,270 J-	6.97 J-
SB-07iB	6/6/2018	54.2-59.2	ND	15.3 J-	2,640 J-	7.97 J-

Sample ID	Date	Screen interval (ft bgs)	Perchlorate (ug/L)	Acetone (ug/L)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)
SB-08iA	6/1/2018	42.5-47.5	6.12	48.7 J-	0.322 J	0.481 J-
SB-08iB	6/1/2018	56.2-61.2	3.97	31.8	ND	ND

Sample ID	Date	Screen interval (ft bgs)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)
SB-04A	5/30/2018	22.8-27.8	5.30 J+	0.789 J

Sample ID	Date	Screen interval (ft bgs)	Perchlorate (ug/L)	Acetone (ug/L)
SB-03A	5/29/2018	19.5-24.5	0.214 J	10.0 J+
SB-03B	5/29/2018	32.7-37.7	0.479	7.71 J+

Sample ID	Date	Screen interval (ft bgs)	Acetone (ug/L)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)	1,2-dichloroethane (ug/L)	trans-1,2-dichloroethene (ug/L)	1,1-dichloroethene (ug/L)	Vinyl Chloride (ug/L)	Tetrachloroethene (ug/L)
SB-05A	5/30/2018	21-26	ND	16,200	7,280	12.6	170	67.4 J	3,420	ND
SB-05B	5/30/2018	30.5-35.5	2.68 J+	12,600	8,420	10.8	137	70.8	2,400	0.818 J



LEGEND

- Soil Boring Location, Sampled 2018
- Intermediate (Upper) Monitoring Well Location, Installed 2018
- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Soil Boring Dry in 2018
- Perchlorate Exceeding Intermediate Zone TRRP PCL (17 µg/L) (Dashed Where Inferred), 2010 and prior
- Trichloroethene Exceeding Intermediate Zone MCL (5 µg/L), 2010 and prior
- Hot Spot DPT Grid ISEB
- Road
- Stream
- Building
- LHAAP-47
- LHAAP Site

NOTES: SB-09i VOCs were reported as soil because lab could not get enough water to decant so ran as solid.
Soil boring data blocks apply to groundwater grab samples. Map data and plume boundaries apply to previous sampling results through 2010.

GROUNDWATER GRAB SAMPLE RESULTS INTERMEDIATE ZONE MAY AND JUNE 2018

LHAAP-47
LONGHORN ARMY AMMUNITION PLANT

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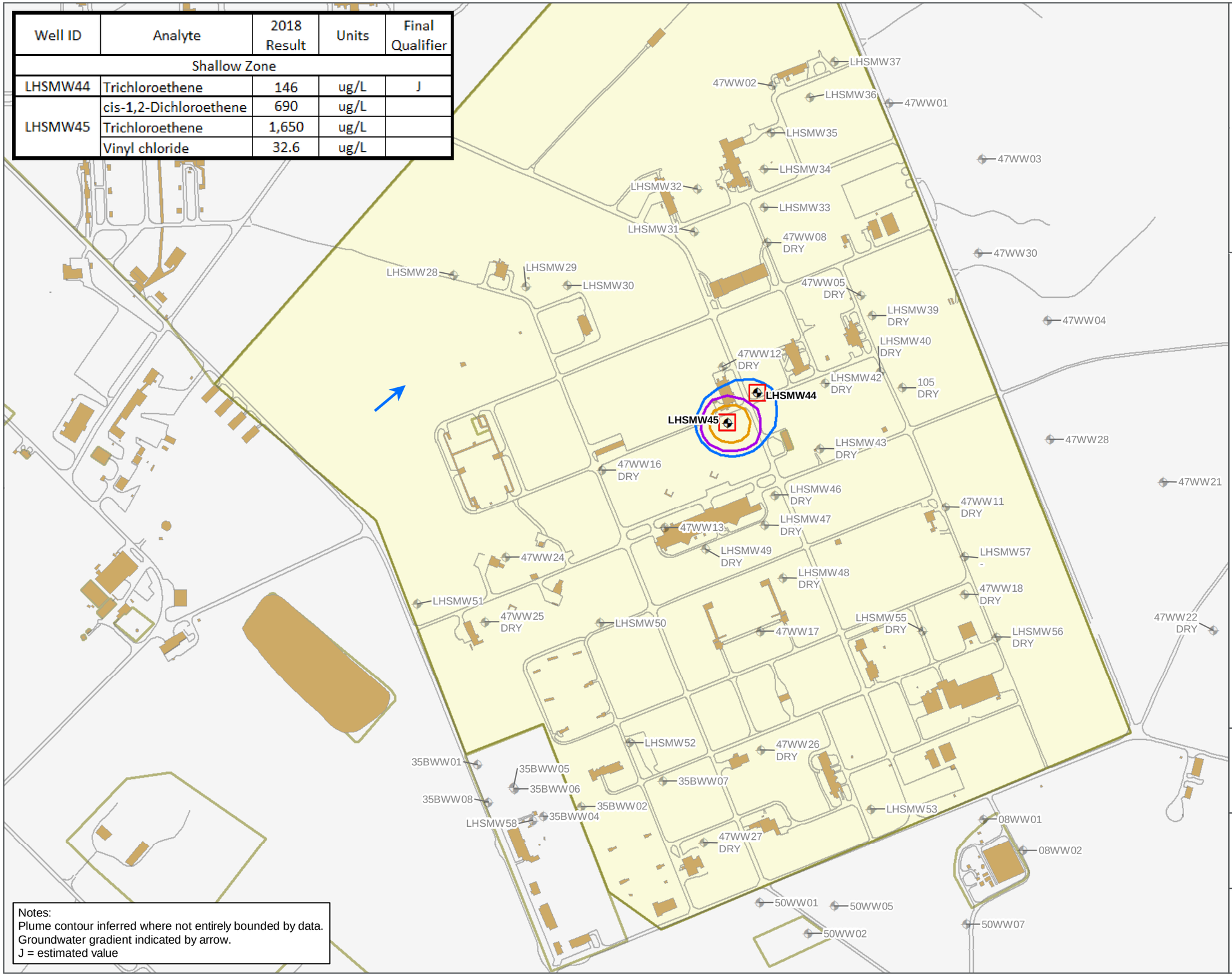
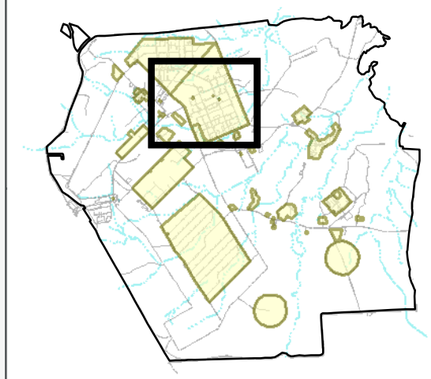
FIGURE 6

PATH: J:\2018\18-025_LHAAP_SITES29_47_18AND24_ROD_(WERNER)\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\LHAAP47\LHAAP47_PRELIMINARY_SAMPLING_RESULTS_INTERMEDIATE_SB.MXD - USER: EBOWLIN - DATE: 3/13/2019

00916055

Well ID	Analyte	2018 Result	Units	Final Qualifier
Shallow Zone				
LHSMW44	Trichloroethene	146	ug/L	J
LHSMW45	cis-1,2-Dichloroethene	690	ug/L	
	Trichloroethene	1,650	ug/L	
	Vinyl chloride	32.6	ug/L	





LEGEND

- Monitoring Well With Contaminant That Exceeds Cleanup Criteria
- Shallow Monitoring Well (Not Sampled)
- Sampled Shallow Monitoring Well
- Vinyl Chloride Exceeding Shallow Zone USEPA MCL (2µg/L)
- cis-1,2-Dichloroethene Exceeding Shallow Zone USEPA MCL (70µg/L)
- Trichloroethene Exceeding Shallow Zone USEPA MCL (5µg/L)
- Road
- Building
- LHAAP-47
- LHAAP Site

Notes:
Plume contour inferred where not entirely bounded by data.
Groundwater gradient indicated by arrow.
J = estimated value

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

SAMPLE RESULTS FOR SHALLOW GROUNDWATER JULY 2018

LHAAP-47
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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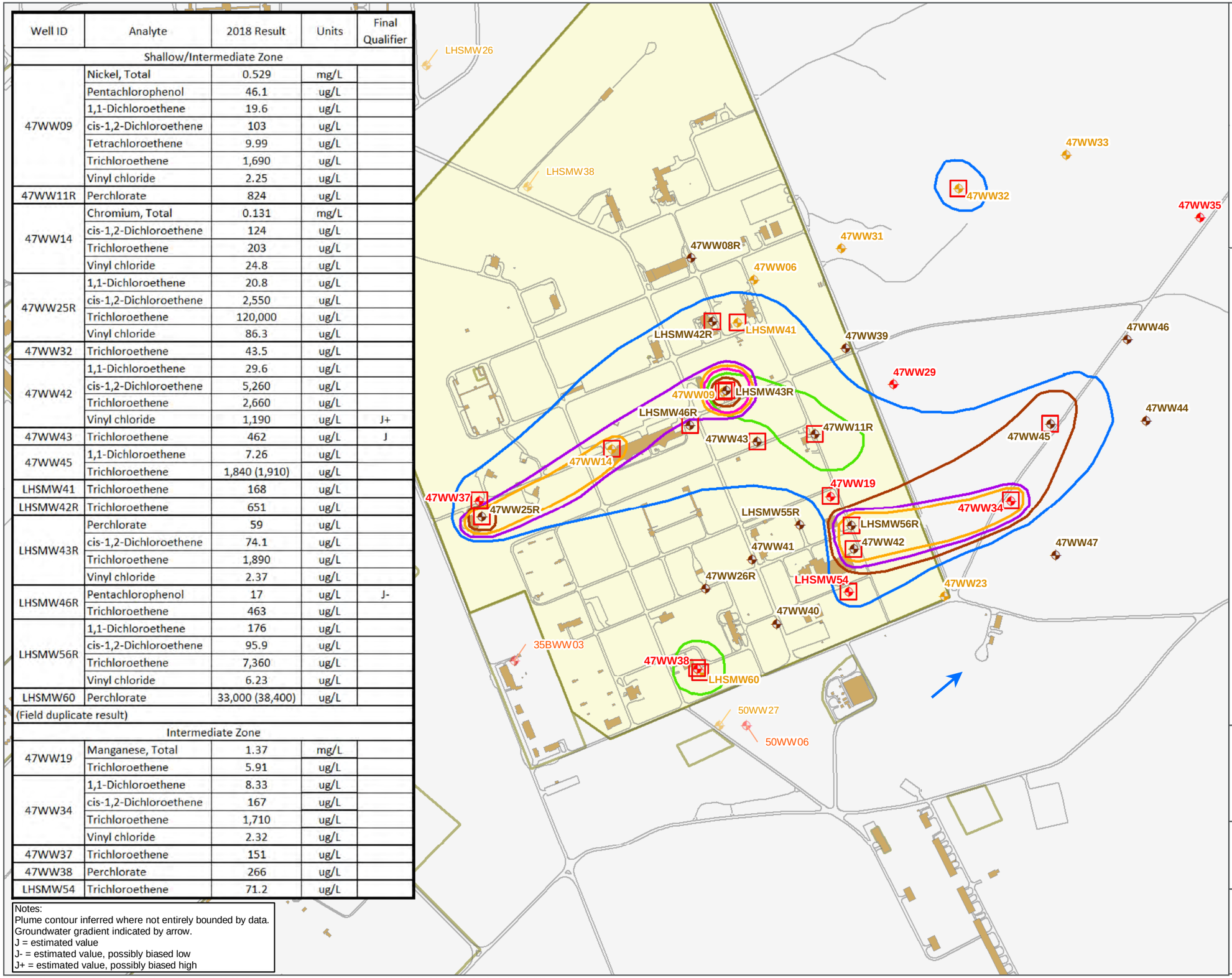
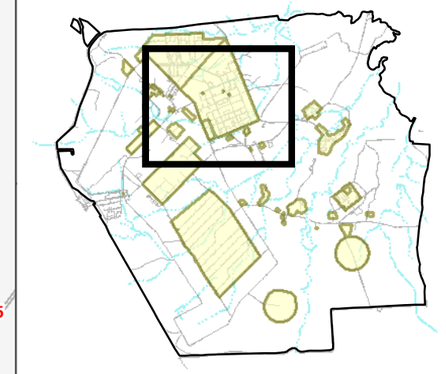
FIGURE 7

PATH: J:\2018\18-025_LHAAP_SITES29_47_18AND24_ROD_(WERNER)\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\LHAAP47\LHAAP47_ALL_CONTAMINANTS_SHALLOW.MXD - USER: EBOWLIN - DATE: 4/10/2019

Well ID	Analyte	2018 Result	Units	Final Qualifier
Shallow/Intermediate Zone				
47WW09	Nickel, Total	0.529	mg/L	
	Pentachlorophenol	46.1	ug/L	
	1,1-Dichloroethene	19.6	ug/L	
	cis-1,2-Dichloroethene	103	ug/L	
	Tetrachloroethene	9.99	ug/L	
	Trichloroethene	1,690	ug/L	
	Vinyl chloride	2.25	ug/L	
47WW11R	Perchlorate	824	ug/L	
47WW14	Chromium, Total	0.131	mg/L	
	cis-1,2-Dichloroethene	124	ug/L	
	Trichloroethene	203	ug/L	
	Vinyl chloride	24.8	ug/L	
47WW25R	1,1-Dichloroethene	20.8	ug/L	
	cis-1,2-Dichloroethene	2,550	ug/L	
	Trichloroethene	120,000	ug/L	
	Vinyl chloride	86.3	ug/L	
47WW32	Trichloroethene	43.5	ug/L	
47WW42	1,1-Dichloroethene	29.6	ug/L	
	cis-1,2-Dichloroethene	5,260	ug/L	
	Trichloroethene	2,660	ug/L	
	Vinyl chloride	1,190	ug/L	J+
47WW43	Trichloroethene	462	ug/L	J
47WW45	1,1-Dichloroethene	7.26	ug/L	
	Trichloroethene	1,840 (1,910)	ug/L	
LHSMW41	Trichloroethene	168	ug/L	
LHSMW42R	Trichloroethene	651	ug/L	
LHSMW43R	Perchlorate	59	ug/L	
	cis-1,2-Dichloroethene	74.1	ug/L	
	Trichloroethene	1,890	ug/L	
	Vinyl chloride	2.37	ug/L	
LHSMW46R	Pentachlorophenol	17	ug/L	J-
	Trichloroethene	463	ug/L	
LHSMW56R	1,1-Dichloroethene	176	ug/L	
	cis-1,2-Dichloroethene	95.9	ug/L	
	Trichloroethene	7,360	ug/L	
	Vinyl chloride	6.23	ug/L	
LHSMW60	Perchlorate	33,000 (38,400)	ug/L	
(Field duplicate result)				
Intermediate Zone				
47WW19	Manganese, Total	1.37	mg/L	
	Trichloroethene	5.91	ug/L	
47WW34	1,1-Dichloroethene	8.33	ug/L	
	cis-1,2-Dichloroethene	167	ug/L	
	Trichloroethene	1,710	ug/L	
	Vinyl chloride	2.32	ug/L	
47WW37	Trichloroethene	151	ug/L	
47WW38	Perchlorate	266	ug/L	
LHSMW54	Trichloroethene	71.2	ug/L	

Notes:
Plume contour inferred where not entirely bounded by data.
Groundwater gradient indicated by arrow.
J = estimated value
J- = estimated value, possibly biased low
J+ = estimated value, possibly biased high





LEGEND

- Monitoring Well With Contaminant That Exceeds Cleanup Criteria
- Sampled Shallow/Intermediate Monitoring Well
- Shallow/Intermediate Monitoring Well (Not Sampled)
- Intermediate Monitoring Well (Not Sampled)
- Sampled Intermediate Monitoring Well
- Sampled Intermediate (Upper) Monitoring Well
- 1,1-Dichloroethene Exceeding Shallow Zone USEPA MCL (7µg/L)
- Vinyl Chloride Exceeding Shallow Zone USEPA MCL (2µg/L)
- cis-1,2-Dichloroethene Exceeding Shallow Zone USEPA MCL (70µg/L)
- Trichloroethene Exceeding Shallow Zone USEPA MCL (5µg/L)
- Perchlorate Exceeding Shallow Zone TRRP PCL (17µg/L)
- Tetrachloroethene Exceeding Shallow Zone USEPA MCL (5µg/L)
- Road
- Building
- LHAAP-47
- LHAAP Site

SAMPLE RESULTS FOR INTERMEDIATE GROUNDWATER JULY AND SEPTEMBER 2018

LHAAP-47
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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FIGURE 8

Attachment 2

Tables

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Table 1. Groundwater Grab Sample Results

Chemical Abstracts Service Number	Chemical Name	Sample ID	235SB01 A	245SB02A	245SB02B	295SB03A	295SB03B	305SB04A	305DUP01 (305SB04A)	305SB05A	305SB05B	255SB06A	245DUP01 (255SB06A)	056SB07iA	066SB07iB	016SB08iA	016SB08iB	046SB09iA*	046SB11iA	046SB11iB
		Boring Location	SB-01	SB-02	SB-02	SB-03	SB-03	SB-04	SB-04	SB-05	SB-05	SB-06	SB-06	SB-07i	SB-07i	SB-08i	SB-08i	SB-09i	SB-11i	SB-11i
		Collection Date	5/23/2018	5/24/2018	5/24/2018	5/29/2018	5/29/2018	5/30/2018	5/30/2018	5/30/2018	5/30/2018	5/25/2018	5/25/2018	6/5/2018	6/6/2018	6/1/2018	6/1/2018	6/4/2018	6/4/2018	6/4/2018
		Depth Interval (ft bgs)	30.2-35.2	25.4-30.4	34.6-39.6	19.5-24.5	32.7-37.7	22.8-27.8	22.8-27.8	21-26	30.5-35.5	19.6-24.6	19.6-24.6	42.2-47.2	54.2-59.2	42.5-47.5	56.2-61.2	39.7-44.7	41.4-46.4	47.6-52.6
		Comparison Levels																		
SW6850-Perchlorate (ug/L)																				
14797-73-0	Perchlorate	17(2)	<0.2	<0.2	<0.2	0.214 J	0.479	<0.2	<0.2	<0.2 UJ	<0.2	<0.2	<0.2	<0.2	<0.2	6.12	3.97	<0.2	<0.2	0.217 J
SW8260B-VOCs (ug/L)																				
75-35-4	1,1-Dichloroethene	7(1)	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**67.4 J**	**70.8**	<1.00	<1.00	6.97 J-	**7.97 J-**	<2.00 UJ	<1.00	<1.00	<1.00	<1.00
107-06-2	1,2-Dichloroethane	5(1)	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	**12.6**	**10.8**	<0.500	<0.500	<2.50 UJ	<2.50 UJ	<1.00 UJ	<0.500	<0.500	<0.500	<0.500
67-64-1	Acetone	22,000(2)	<5.00	3.31 J	5.04 J	10.0 J+	7.71 J+	5.30 J+	5.81 J+	<5.00	2.68 J+	<5.00	<5.00	15.2 J-	<25.0 UJ	48.7 J-	31.8	15.3 J	10.8	22.4
67-66-3	Chloroform	80(1)	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<1.25 UJ	<1.25 UJ	<0.500 UJ	<0.250	<0.250	<0.250	<0.250
156-59-2	cis-1,2-Dichloroethene	70(1)	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	**16,200**	**12,600**	0.339 J	0.383 J	16.7 J-	15.3 J-	0.322 J	<0.500	4.07	<0.500	<0.500
127-18-4	Tetrachloroethene	5(1)	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	0.818 J	<0.500	<0.500	<2.50 UJ	<2.50 UJ	<1.00 UJ	<0.500	<0.500	<0.500	<0.500
156-60-5	trans-1,2-Dichloroethene	100(1)	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	**170**	**137**	<0.500	<0.500	<2.50 UJ	<2.50 UJ	<1.00 UJ	<0.500	<0.500	<0.500	<0.500
79-01-6	Trichloroethene	5(1)	<0.500	<0.500	<0.500	<0.500	<0.500	0.789 J	0.756 J	**7,280**	**8,420**	**61.3**	**75**	**2,270 J-**	**2,640 J-**	0.481 J-	<0.500	<0.500	<0.500	<0.500
75-01-4	Vinyl Chloride	2(1)	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	**3,420**	**2,400**	<0.500	<0.500	<2.50 UJ	<2.50 UJ	<0.500 UJ	<0.500	<0.500	<0.500	<0.500

** = due to high sediment content, sample results were reported as soil, with ug/kg units*
(1) = EPA MCL
(2) = TRRP $^{GW}GW_{ing}$ PCL
Bolded result indicates exceedance of comparison level
ft bgs = feet below ground surface
ug/L = micrograms per liter
J = estimated value
UJ = not detected, level of detection is estimated
J+ = estimated value, possibly biased high
J- = estimated value, possibly biased low

Table 2. Groundwater Elevations

Well ID	Newly Installed	Sampled	Zone[1]	Northing[2]	Easting[2]	Ground Surface Elevation (ft MSL)[3]	TOC Elevation (ft MSL)[3]	TOC AGS (ft MSL)[3]	Well Depth (ft btoc)	Water Level (ft btoc)	Water Elevation (ft MSL)[3]	Date Measured	Time	Notes
47WW03			Shallow	6961546.93	3310493.93	191.86	195.24	3.38	26.98	26.04	169.20	9/15/2018	1555	well ID worn off, lock won't latch; less than 2' water
47WW04			Shallow	6960690.1	3310838.47	187.83	190.90	3.07	21.89	20.11	170.79	9/15/2018	1510	less than 2' water
47WW05			Shallow	6960821.11	3309848.45	195.79	198.55	2.76	19*	DRY	-	7/7/2018	-	noted dry during development
47WW06		x	Shallow/Intermediate	6960826.26	3309845.61	195.79	199.02	3.23	47.92	27.94	171.08	9/15/2018	1645	
47WW08R	x	x	Intermediate (Upper)	6960984.713	3309381.553	192.61	195.06	2.45	41.86	28.14	166.92	9/15/2018	1630	
47WW09		x	Shallow/Intermediate	6960006.04	3309623.61	197.72	201.04	3.32	41.25	27.72	173.32	9/15/2018	1710	no well cap, no lock
47WW11R	x	x	Intermediate (Upper)	6959694.985	3310292.3	196.44	198.98	2.54	37.71	26.59	172.39	9/15/2018	1235	
47WW12			Shallow	6960442.63	3309114.13	199.02	202.27	3.25	21.90	DRY	-	9/15/2018	1700	cover doesn't close
47WW13			Shallow	6959590.22	3308809.1	202.02	204.97	2.95	20.01	16.70	188.27	9/15/2018	1155	insufficient recharge during development; not sampled
47WW14		x	Shallow/Intermediate	6959587.31	3308802.09	202.22	205.00	2.78	51.90	29.76	175.24	9/15/2018	1200	
47WW16			Shallow	6959895.12	3308477.27	200.62	203.73	3.11	19*	DRY	-	7/9/2018	-	noted dry during development
47WW18			Shallow	6959236.15	3310398.27	196.37	199.69	3.32	21*	DRY	-	7/9/2018	-	noted dry during development
47WW19		x	Intermediate	6959241.12	3310406.27	196.01	198.93	2.92	64.46	25.69	173.24	9/15/2018	1720	lock won't latch
47WW21			Shallow	6959832.47	3311452.33	184.44	187.59	3.15	23.93	17.95	169.64	9/15/2018	1355	insufficient recharge during development; not sampled
47WW22			Shallow	6959044	3311719	192.48	195.62	3.14	22.61	DRY	-	9/16/2018	1130	had to cut lock, hinge broken
47WW23		x	Shallow/Intermediate	6958503.8	3311242.96	194.76	197.86	3.10	35.15	25.42	172.44	9/15/2018	1400	well ID worn off, lock won't latch
47WW25R	x	x	Intermediate (Upper)	6959088.082	3307846.571	204.57	207.04	2.47	42.73	31.28	175.76	9/15/2018	1150	
47WW26R	x	x	Intermediate (Upper)	6958560.122	3309490.491	199.82	202.12	2.30	42.05	31.35	170.77	9/15/2018	1725	
47WW27			Shallow	6957917.773	3309015.213	197.36	200.97	3.61	20*	DRY	-	7/9/2018	-	noted dry during development
47WW28			Shallow	6960058.222	3310852.659	192.00	194.43	2.43	25.12	23.48	170.95	9/15/2018	1345	well ID worn off, lock won't latch; less than 2' water
47WW29		x	Intermediate	6960059.441	3310868.574	191.60	194.08	2.48	64.99	22.10	171.98	9/15/2018	1340	well ID worn off, lock won't latch
47WW31		x	Shallow/Intermediate	6961056.051	3310483.732	194.60	196.94	2.34	52.35	27.03	169.91	9/15/2018	1515	
47WW32		x	Shallow/Intermediate	6961495.383	3311345.922	191.10	193.82	2.72	35.52	24.72	169.10	9/15/2018	1525	lock won't latch, 2" well
47WW33		x	Shallow/Intermediate	6961743	3312137	178.90	181.58	2.68	37.30	13.54	168.04	9/15/2018	1535	
47WW34		x	Intermediate	6959209	3311731	188.90	191.43	2.53	45.32	21.02	170.41	9/15/2018	1430	no lock
47WW35		x	Intermediate	6961283	3313119	187.10	189.90	2.80	49.86	21.60	168.30	9/15/2018	1455	
47WW36			Intermediate	6960256	3314190	193.80	196.46	2.66	33.20	DRY	-	7/13/2018	-	went dry during development; remained dry
47WW37		x	Intermediate	6959208	3307829	204.90	207.87	2.97	68.82	32.33	175.54	9/15/2018	1145	
47WW38		x	Intermediate	6957976	3309428	195.30	198.91	3.61	60.01	23.27	175.64	9/15/2018	1110	no lock, 2" well
47WW39	x	x	Intermediate (Upper)	6960322.197	3310517.812	192.77	194.91	2.14	42.13	24.07	170.84	9/15/2018	1335	
47WW40	x	x	Intermediate (Upper)	6958303.453	3310011.946	195.34	198.24	2.90	42.39	23.71	174.53	9/15/2018	1320	
47WW41	x	x	Intermediate (Upper)	6958774.291	3309828.457	198.81	201.48	2.67	40.03	28.06	173.42	9/15/2018	1315	
47WW42	x	x	Intermediate (Upper)	6958850.745	3310575.554	192.68	195.22	2.55	43.01	22.13	173.09	9/15/2018	1250	
47WW43	x	x	Intermediate (Upper)	6959639.624	3309868.697	194.11	196.41	2.30	35.39	25.52	170.89	9/15/2018	1220	
47WW44	x	x	Intermediate (Upper)	6959793.183	3312722.693	192.66	195.04	2.38	62.00	26.35	168.69	9/15/2018	1440	
47WW45	x	x	Intermediate (Upper)	6959769.404	3312018.475	186.11	188.05	1.94	50.49	19.36	168.69	9/15/2018	1435	
47WW46	x	x	Intermediate (Upper)	6960386.394	3312581.587	188.53	191.05	2.52	57.90	21.22	169.83	9/15/2018	1450	
47WW47	x	x	Intermediate (Upper)	6958805.997	3312059.497	193.56	196.08	2.52	55.45	25.09	170.99	9/15/2018	1415	
LHSMW40			Shallow	6960414.3	3309954.4	196.90	199.99	3.09	16.12	DRY	-	9/15/2018	1650	pad is washing into adjacent drainage

Table 2. Groundwater Elevations

Well ID	Newly Installed	Sampled	Zone[1]	Northing[2]	Easting[2]	Ground Surface Elevation (ft MSL)[3]	TOC Elevation (ft MSL)[3]	TOC AGS (ft MSL)[3]	Well Depth (ft btoc)	Water Level (ft btoc)	Water Elevation (ft MSL)[3]	Date Measured	Time	Notes
LHSMW41		x	Shallow/Intermediate	6960512.7	3309723.6	197.10	199.85	2.75	38.10	27.10	172.75	7/21/2018	1320	water level from sampling date
LHSMW42R	x	x	Intermediate (Upper)	6960519.58	3309540.589	198.40	200.61	2.20	41.95	28.24	172.37	9/15/2018	1635	
LHSMW43R	x	x	Intermediate (Upper)	6960015.708	3309643.464	197.01	199.31	2.30	36.91	26.51	172.80	9/15/2018	1715	
LHSMW44		x	Shallow	6960305.6	3309300.2	197.45	200.36	2.91	39.34	27.05	173.31	9/15/2018	1655	well ID worn off
LHSMW45		x	Shallow	6960147.1	3309141	198.74	201.39	2.65	39.33	27.64	173.75	9/15/2018	1705	
LHSMW46R	x	x	Intermediate (Upper)	6959758.72	3309375.428	198.65	201.37	2.72	41.30	27.76	173.61	9/15/2018	1205	
LHSMW47			Shallow	6959603.8	3309336.6	197.92	200.54	2.62	16*	DRY	-	7/13/2018	-	noted dry during development
LHSMW49			Shallow	6959476.9	3309023.4	198.95	201.74	2.79	16*	DRY	-	7/9/2018	-	noted dry during development
LHSMW50			Shallow	6959084.4	3308465.7	202.33	205.17	2.84	30.40	29.06	176.11	9/15/2018	1135	lock won't latch; less than 2' water
LHSMW54		x	Intermediate	6958536	3310539	191.08	193.71	2.63	45.45	20.22	173.49	9/15/2018	1300	well ID worn off
LHSMW55R	x	x	Intermediate (Upper)	6959029.227	3310180.193	196.16	198.76	2.60	38.17	25.33	173.43	9/15/2018	1305	
LHSMW56R	x	x	Intermediate (Upper)	6959023.735	3310560.58	195.49	198.05	2.56	37.48	25.17	172.88	9/15/2018	1245	
LHSMW57			Shallow	6959434.2	3310398.6	197.56	200.53	2.97	17.45	DRY	-	7/12/2018	-	went dry during development; remained dry
LHSMW60		x	Shallow/Intermediate	6957946	3309450	196.14	199.28	3.14	29.32	23.29	175.99	9/15/2018	1115	
LHSMW61			Shallow	6958546.3	3313186.2	195.23	198.29	3.06	28.63	27.03	171.26	9/15/2018	1405	well ID worn off, no lock; less than 2' water
105			Shallow	6960331.5	3310068.4	196.97	199.41	2.44	27*	DRY	-	7/13/2018	-	noted dry during development
50WW01			Shallow	6957599.96	3309311	195.29	198.50	3.21	23.25	21.64	176.86	9/15/2018	1100	
47WW01			Shallow	6961843.18	3310000.12	191.21	194.40	3.19	19.00	-	-	-	-	not monitored during PSI effort
47WW02			Shallow	6961934.03	3309378.17	194.70	197.23	2.53	18.00	-	-	-	-	not monitored during PSI effort
47WW08			Shallow	6961102.58	3309353.97	196.43	199.45	3.02	19.00	-	-	-	-	not monitored during PSI effort; dry well that was replaced
47WW11			Shallow	6959699.09	3310298.06	196.24	199.14	2.90	19.00	-	-	-	-	not monitored during PSI effort; dry well that was replaced
47WW17			Shallow	6959040.27	3309316.44	198.44	201.76	3.32	19.00	-	-	-	-	not monitored during PSI effort
47WW24			Shallow	6959433.332	3307965.291	204.39	207.90	3.51	21.00	-	-	-	-	not monitored during PSI effort
47WW25			Shallow	6959089.921	3307856.194	204.68	208.53	3.85	25.00	-	-	-	-	not monitored during PSI effort; dry well that was replaced
47WW26			Shallow	6958409.003	3309317.473	200.56	203.99	3.43	20.00	-	-	-	-	not monitored during PSI effort; dry well that was replaced
47WW30			Shallow	6961047.189	3310472.4	194.61	197.12	2.50	22.60	-	-	-	-	not monitored during PSI effort
LHSMW28			Shallow	6960930	3307688	202.66	205.52	2.86	17.00	-	-	-	-	not monitored during PSI effort
LHSMW29			Shallow	6960870	3308072	200.51	203.24	2.73	20.80	-	-	-	-	not monitored during PSI effort
LHSMW30			Shallow	6960875	3308292	200.68	203.74	3.06	19.00	-	-	-	-	not monitored during PSI effort
LHSMW31			Shallow	6961160	3308967	198.09	201.03	2.94	27.90	-	-	-	-	not monitored during PSI effort
LHSMW32			Shallow	6961387	3308982	197.20	200.18	2.98	16.00	-	-	-	-	not monitored during PSI effort
LHSMW33			Shallow	6961290	3309335	196.27	199.39	3.12	19.00	-	-	-	-	not monitored during PSI effort
LHSMW34			Shallow	6961493	3309337	195.85	198.59	2.74	22.50	-	-	-	-	not monitored during PSI effort
LHSMW35			Shallow	6961685	3309373	195.40	198.37	2.97	21.00	-	-	-	-	not monitored during PSI effort
LHSMW36			Shallow	6961872	3309579	193.74	196.53	2.79	26.50	-	-	-	-	not monitored during PSI effort
LHSMW37			Shallow	6962064	3309709	192.23	195.18	2.95	34.00	-	-	-	-	not monitored during PSI effort
LHSMW38			Shallow	6961506	3308184	197.84	200.84	3.00	28.00	-	-	-	-	not monitored during PSI effort
LHSMW39			Shallow	6960715	3309910	195.78	198.71	2.93	18.00	-	-	-	-	not monitored during PSI effort
LHSMW42			Shallow	6960355	3309660	197.18	200.29	3.11	19.80	-	-	-	-	not monitored during PSI effort; dry well that was replaced

Table 2. Groundwater Elevations

Well ID	Newly Installed	Sampled	Zone[1]	Northing[2]	Easting[2]	Ground Surface Elevation (ft MSL)[3]	TOC Elevation (ft MSL)[3]	TOC AGS (ft MSL)[3]	Well Depth (ft btoc)	Water Level (ft btoc)	Water Elevation (ft MSL)[3]	Date Measured	Time	Notes
LHSMW43			Shallow	6960010	3309633	197.38	200.26	2.88	19.50	-	-	-	-	not monitored during PSI effort; dry well that was replaced
LHSMW46			Shallow	6959763	3309392	198.46	201.72	3.26	17.30	-	-	-	-	not monitored during PSI effort; dry well that was replaced
LHSMW48			Shallow	6959323	3309436	199.30	202.06	2.76	199.30	-	-	-	-	not monitored during PSI effort; dry well
LHSMW51			Shallow	6959185	3307497	205.60	208.50	2.90	19.00	-	-	-	-	not monitored during PSI effort
LHSMW52			Shallow	6958448.8	3308621.6	202.6	205.91	3.31	22.00	-	-	-	-	not monitored during PSI effort
LHSMW53			Shallow	6958096.73	3309903.12	194.84	197.61	2.77	14.00	-	-	-	-	not monitored during PSI effort
LHSMW55			Shallow	6959043.13	3310174.99	196.47	193.71	-2.76	17.50	-	-	-	-	not monitored during PSI effort; dry well that was replaced
LHSMW56			Shallow	6959009.13	3310570.56	195.36	198.59	3.23	20.00	-	-	-	-	not monitored during PSI effort; dry well that was replaced
50WW27			Lower Shallow	6957556.13	3309590.81	193.84	196.22	2.38	57.4	-	-	-	-	not monitored during PSI effort

NM: not measured
AGS: above ground surface
btoc: below top of casing
ft: feet
MSL: mean sea level
** ft below ground surface, taken from 2002 RI*
[1] Shallow/Intermediate classified per 2011 Feasibility Study
[2] NAD_1983_StatePlane_Texas_North_Central_FIPS_4202_Feet
[3] North American Vertical Datum of 1988

Table 3. Monitoring Well Groundwater Sample Results

Chemical Abstracts Service Number	Chemical Name	Well ID	47WW06	47WW08R	47WW09	47WW11R	47WW14	47WW19	47WW23	47WW25R	47WW26R	47WW29	47WW31	47WW32	47WW33	47WW34
		Collection Date	7/20/2018	7/19/2018	9/18/2018	7/19/2018	7/20/2018	7/21/2018	7/20/2018	7/20/2018	7/21/2018	7/19/2018	7/19/2018	7/19/2018	7/21/2018	7/21/2018
		Zone[3]	Shallow/ Intermediate	Intermediate (Upper)	Shallow/ Intermediate	Intermediate (Upper)	Shallow/ Intermediate	Intermediate	Shallow/ Intermediate	Intermediate (Upper)	Intermediate (Upper)	Intermediate	Shallow/ Intermediate	Shallow/ Intermediate	Shallow/ Intermediate	Intermediate
		Comparison Levels														
SW6850-Perchlorate (ug/L)																
14797-73-0	Perchlorate	17[2]	NA	NA	3.03	**824**	NA	<0.2	<0.2	NA	0.823	<0.2	NA	NA	NA	NA
SW6010/6020/3015A-Metals (mg/L)																
7429-90-5	Aluminum, Total	24[2]	0.194 J	<0.200	<0.200	NA	<0.200	<0.200	NA	NA	NA	NA	NA	NA	NA	NA
7440-47-3	Chromium, Total	0.1[1]	0.0493	<0.0200	<0.0200	NA	**0.131**	0.0643	NA	NA	NA	NA	NA	NA	NA	NA
7440-48-4	Cobalt, Total	0.24[2]	0.0115 J	<0.0200	<0.0200	NA	<0.0200	<0.0200	NA	NA	NA	NA	NA	NA	NA	NA
7439-96-5	Manganese, Total	1.1[2]	0.240	0.209	0.154	NA	0.102	**1.37**	NA	NA	NA	NA	NA	NA	NA	NA
7440-02-0	Nickel, Total	0.49[2]	0.0271 J	<0.0400	**0.529**	NA	0.0638 J	0.0214 J	NA	NA	NA	NA	NA	NA	NA	NA
7440-22-4	Silver, Total	0.12[2]	<0.0100	<0.0100	<0.0100 UJ	NA	<0.0100	<0.0100	NA	NA	NA	NA	NA	NA	NA	NA
7440-24-6	Strontium, Total	15[2]	0.611	3.78	2.12	NA	1.38	3.04	NA	NA	NA	NA	NA	NA	NA	NA
7440-31-5	Tin, Total	15[2]	<0.500	<0.500	<0.500	NA	<0.500	<0.500	NA	NA	NA	NA	NA	NA	NA	NA
7440-62-2	Vanadium, Total	0.044[2]	<0.0100	<0.0100	<0.0100	NA	<0.0100	<0.0100	NA	NA	NA	NA	NA	NA	NA	NA
7440-36-0	Antimony, Total	0.0006[1]	<0.00100	<0.00100	<0.00100	NA	<0.00100	<0.00100	NA	NA	NA	NA	NA	NA	NA	NA
7440-38-2	Arsenic, Total	0.01[1]	**0.0262**	0.00676	0.00262	NA	0.00168 J	0.00319	NA	NA	NA	NA	NA	NA	NA	NA
7440-43-9	Cadmium, Total	0.005[1]	<0.000600	<0.000600	<0.000600	NA	<0.000600	<0.000600	NA	NA	NA	NA	NA	NA	NA	NA
7440-28-0	Thallium, Total	0.002[1]	0.000112 J	<0.000200	<0.000200	NA	<0.000200	<0.000200	NA	NA	NA	NA	NA	NA	NA	NA
SW8260B-VOCs (ug/L)																
75-35-4	1,1-Dichloroethene	7[1]	NA	<1.00	**19.6**	NA	3.39 J+	<1.00	<1.00	**20.8**	NA	<1.00	<1.00 UJ	<1.00	<1.00	**8.33**
107-06-2	1,2-Dichloroethane	5[1]	NA	<0.500	0.283 J	NA	<0.500	<0.500	<0.500	0.310 J	NA	<0.500	<0.500 UJ	<0.500	<0.500	0.486 J
67-64-1	Acetone	22,000[2]	NA	<5.00	<5.00	NA	<5.00	<5.00	4.18 J+	3.42 J+	NA	<5.00	<5.00 UJ	<5.00	12.1 J+	<5.00
67-66-3	Chloroform	80[1]	NA	<0.250	<0.250	NA	<0.250	<0.250	<0.250	1.16	NA	<0.250	<0.250 UJ	<0.250	<0.250	<0.250
156-59-2	cis-1,2-Dichloroethene	70[1]	NA	<0.500	**103**	NA	**124**	<0.500	<0.500	**2,550**	NA	<0.500	<0.500 UJ	1.41	0.304 J	**167**
127-18-4	Tetrachloroethene	5[1]	NA	<0.500	**9.99**	NA	<0.500	<0.500	<0.500	0.840 J	NA	<0.500	<0.500 UJ	<0.500	<0.500	<0.500
156-60-5	trans-1,2-Dichloroethene	100[1]	NA	<0.500	0.861 J	NA	1.16	<0.500	<0.500	11.0	NA	<0.500	<0.500 UJ	<0.500	<0.500	1.86
79-01-6	Trichloroethene	5[1]	NA	<0.500	**1,690**	NA	**203**	**5.91**	1.38	**120,000**	NA	<0.500	1.10 J	**43.5**	1.36	**1,710**
75-01-4	Vinyl chloride	2[1]	NA	<0.500	**2.25**	NA	**24.8**	<0.500	<0.500	**86.3**	NA	<0.500	<0.500 UJ	<0.500	<0.500	**2.32**
SW8151A-Herbicides (ug/L)																
87-86-5	Pentachlorophenol	1[1]	NA	NA	**46.1**	NA	<0.222 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW8270C-SVOCs (ug/L)																
117-81-7	bis(2-Ethylhexyl)phthalate	6[1]	NA	NA	<6.74	NA	<6.74	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW8330-Explosives (ug/L)																
118-96-7	2,4,6-Trinitrotoluene	12[2]	NA	NA	<0.550	<0.568	<0.562	NA	NA	NA	NA	NA	NA	NA	NA	NA
121-14-2	2,4-Dinitrotoluene	1.3[2]	NA	NA	<0.550	<0.568	<0.562	NA	NA	NA	NA	NA	NA	NA	NA	NA
606-20-2	2,6-Dinitrotoluene	1.3[2]	NA	NA	<0.550	<0.568	<0.562	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA= not analyzed
(1) = EPA MCL
(2) = TRRP $^{GW}GW_{Ing}$ PCL
(3) = Shallow/Intermediate classified per 2011 Feasibility Study
Bolded result indicates exceedance of comparison level
mg/L = milligrams per liter
ug/L = micrograms per liter
J = estimated value
J- = estimated value, possibly biased low
J+ = estimated value, possibly biased high
UJ = not detected, level of detection is estimated

Table 3. Monitoring Well Groundwater Sample Results

Chemical Abstracts Service Number	Chemical Name	Well ID	47WW35	DUP-03 (47WW35)	47WW37	47WW38	47WW39	47WW40	47WW41	47WW42	47WW43	47WW44	47WW45	DUP-04 (47WW45)	47WW46	47WW47
		Collection Date	7/21/2018	7/21/2018	9/16/2018	9/16/2018	7/19/2018	9/17/2018	9/17/2018	9/18/2018	9/17/2018	9/17/2018	9/17/2018	9/17/2018	9/17/2018	9/17/2018
		Zone[3]	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)
		Comparison Levels														
SW6850-Perchlorate (ug/L)																
14797-73-0	Perchlorate	17[2]	NA	NA	NA	**266**	<0.2	<0.2	<0.200	NA	<0.200 UJ	<0.200 UJ	<0.200 UJ	<0.200	<0.200	<0.200
SW6010/6020/3015A-Metals (mg/L)																
7429-90-5	Aluminum, Total	24[2]	NA	NA	<0.200	<0.200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-47-3	Chromium, Total	0.1[1]	NA	NA	0.0112 J	<0.0200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-48-4	Cobalt, Total	0.24[2]	NA	NA	<0.0200	<0.0200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7439-96-5	Manganese, Total	1.1[2]	NA	NA	0.0328	0.163	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-02-0	Nickel, Total	0.49[2]	NA	NA	<0.0400	<0.0400	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-22-4	Silver, Total	0.12[2]	NA	NA	<0.0100 UJ	<0.0100 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-24-6	Strontium, Total	15[2]	NA	NA	2.69	0.810	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-31-5	Tin, Total	15[2]	NA	NA	<0.500	<0.500	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-62-2	Vanadium, Total	0.044[2]	NA	NA	<0.0100	<0.0100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-36-0	Antimony, Total	0.0006[1]	NA	NA	<0.00100	<0.00100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-38-2	Arsenic, Total	0.01[1]	NA	NA	0.00197 J	0.00273	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-43-9	Cadmium, Total	0.005[1]	NA	NA	<0.000600	<0.000600	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7440-28-0	Thallium, Total	0.002[1]	NA	NA	<0.000200	<0.000200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW8260B-VOCs (ug/L)																
75-35-4	1,1-Dichloroethene	7[1]	<1.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00 UJ	**29.6**	<1.00 UJ	<1.00	**7.26**	**7.07**	<1.00	<1.00
107-06-2	1,2-Dichloroethane	5[1]	<0.500	<0.500	<0.500	<0.500	<0.500	NA	<0.500 UJ	4.18	<0.500 UJ	<0.500	<0.500	<0.500	<0.500	<0.500
67-64-1	Acetone	22,000[2]	<5.00	<5.00	<5.00	<5.00	<5.00	NA	< 5.00 UJ	4.49 J+	2.59 J	4.19 J+	9.14 J+	9.10 J+	<5.00	3.82 J+
67-66-3	Chloroform	80[1]	<0.250	<0.250	<0.250	<0.250	<0.250	NA	<0.250 UJ	<0.250	<0.250 UJ	<0.250	<0.250	<0.250	<0.250	<0.250
156-59-2	cis-1,2-Dichloroethene	70[1]	<0.500	<0.500	11.1	<0.500	<0.500	NA	<0.500 UJ	**5,260**	0.917 J	1.43	15.2	15.2	0.571 J	0.398 J
127-18-4	Tetrachloroethene	5[1]	<0.500	<0.500	<0.500	<0.500	<0.500	NA	<0.500 UJ	<0.500	<0.500 UJ	<0.500	<0.500	<0.500	<0.500	<0.500
156-60-5	trans-1,2-Dichloroethene	100[1]	<0.500	<0.500	<0.500	<0.500	<0.500	NA	<0.500 UJ	56.5	<0.500 UJ	<0.500	0.352 J	0.271 J	<0.500	<0.500
79-01-6	Trichloroethene	5[1]	<0.500 UJ	1.23 J	**151**	1.07 J+	<0.500	NA	0.439 J	**2,660**	**462 J**	3.51 J+	**1,840**	**1,910**	2.29 J+	2.25 J+
75-01-4	Vinyl chloride	2[1]	<0.500	<0.500	0.253 J	<0.500	<0.500	NA	<0.500 UJ	**1,190 J+**	<0.500 UJ	<0.500	0.602 J	0.621 J	<0.500	<0.500
SW8151A-Herbicides (ug/L)																
87-86-5	Pentachlorophenol	1[1]	NA	NA	<0.228	<0.254	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW8270C-SVOCs (ug/L)																
117-81-7	bis(2-Ethylhexyl)phthalate	6[1]	NA	NA	<6.90	<7.50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW8330-Explosives (ug/L)																
118-96-7	2,4,6-Trinitrotoluene	12[2]	NA	NA	NA	NA	NA	NA	NA	<0.538	<0.626	NA	NA	NA	NA	NA
121-14-2	2,4-Dinitrotoluene	1.3[2]	NA	NA	NA	NA	NA	NA	NA	<0.538	<0.626	NA	NA	NA	NA	NA
606-20-2	2,6-Dinitrotoluene	1.3[2]	NA	NA	NA	NA	NA	NA	NA	<0.538	<0.626	NA	NA	NA	NA	NA

NA= not analyzed
(1) = EPA MCL
(2) = TRRP $^{GW}GW_{Ing}$ PCL
(3) = Shallow/Intermediate classified per 2011 Feasibility Study
Bolded result indicates exceedance of comparison level
mg/L = milligrams per liter
ug/L = micrograms per liter
J = estimated value
J- = estimated value, possibly biased low
J+ = estimated value, possibly biased high
UJ = not detected, level of detection is estimated

Table 3. Monitoring Well Groundwater Sample Results

Chemical Abstracts Service Number	Chemical Name	Well ID	LHSMW41	LHSMW42R	LHSMW43R	LHSMW44	LHSMW45	LHSMW46R	LHSMW54	LHSMW55R	DUP-02 (LHSMW55R)	LHSMW56R	LHSMW60	DUP-01 (LHSMW60)
		Collection Date	7/21/2018	7/21/2018	7/19/2018	7/22/2018	7/21/2018	7/19/2018	7/21/2018	7/20/2018	7/20/2018	7/21/2018	7/20/2018	7/20/2018
		Zone[3]	Shallow/ Intermediate	Intermediate (Upper)	Intermediate (Upper)	Shallow	Shallow	Intermediate (Upper)	Intermediate	Intermediate (Upper)	Intermediate (Upper)	Intermediate (Upper)	Shallow/ Intermediate	Shallow/ Intermediate
		Comparison Levels												
SW6850-Perchlorate (ug/L)														
14797-73-0	Perchlorate	17[2]	NA	<0.200	**59**	NA	NA	<0.200	<0.200	0.107 J	<0.200	NA	**33,000**	**38,400**
SW6010/6020/3015A-Metals (mg/L)														
7429-90-5	Aluminum, Total	24[2]	NA	NA	NA	NA	NA	0.139 J	NA	NA	NA	NA	<0.200	<0.200
7440-47-3	Chromium, Total	0.1[1]	NA	NA	NA	NA	NA	<0.0200	NA	NA	NA	NA	0.0433	0.0363 J
7440-48-4	Cobalt, Total	0.24[2]	NA	NA	NA	NA	NA	<0.0200	NA	NA	NA	NA	<0.0200	<0.0200
7439-96-5	Manganese, Total	1.1[2]	NA	NA	NA	NA	NA	0.387	NA	NA	NA	NA	0.0551	0.0437
7440-02-0	Nickel, Total	0.49[2]	NA	NA	NA	NA	NA	<0.0400	NA	NA	NA	NA	0.381 J	0.357
7440-22-4	Silver, Total	0.12[2]	NA	NA	NA	NA	NA	<0.0100	NA	NA	NA	NA	<0.0100	<0.0100
7440-24-6	Strontium, Total	15[2]	NA	NA	NA	NA	NA	0.383	NA	NA	NA	NA	0.747	0.733
7440-31-5	Tin, Total	15[2]	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	<0.500
7440-62-2	Vanadium, Total	0.044[2]	NA	NA	NA	NA	NA	<0.0100	NA	NA	NA	NA	<0.0100	<0.0100
7440-36-0	Antimony, Total	0.0006[1]	NA	NA	NA	NA	NA	<0.00100	NA	NA	NA	NA	<0.00100	<0.00100
7440-38-2	Arsenic, Total	0.01[1]	NA	NA	NA	NA	NA	0.00486	NA	NA	NA	NA	0.00173 J	0.00183 J
7440-43-9	Cadmium, Total	0.005[1]	NA	NA	NA	NA	NA	<0.000600	NA	NA	NA	NA	<0.000600	<0.000600
7440-28-0	Thallium, Total	0.002[1]	NA	NA	NA	NA	NA	<0.000200	NA	NA	NA	NA	<0.000200	<0.000200
SW8260B-VOCs (ug/L)														
75-35-4	1,1-Dichloroethene	7[1]	0.560 J	5.28	3.26	0.755 J	5.37 J+	1.47 J	<1.00	<1.00	<1.00	**176**	<1.00	<1.00
107-06-2	1,2-Dichloroethane	5[1]	<0.500	<0.500	<0.500	<0.500 UJ	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
67-64-1	Acetone	22,000[2]	5.60 J+	<5.00	<5.00	<5.00 UJ	<5.00	2.74 J+	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
67-66-3	Chloroform	80[1]	<0.250	<0.250	<0.250	<0.250 UJ	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250
156-59-2	cis-1,2-Dichloroethene	70[1]	2.89	25.1	**74.1**	11.0 J	**690**	25.8	0.734 J	<0.500	<0.500	**95.9**	<0.500	<0.500
127-18-4	Tetrachloroethene	5[1]	<0.500	<0.500	<0.500	<0.500 UJ	<0.500	<0.500	<0.500	<0.500	<0.500	0.763 J	<0.500	<0.500
156-60-5	trans-1,2-Dichloroethene	100[1]	<0.500	1.85	1.69	0.782 J	2.62	0.909 J	<0.500	<0.500	<0.500	1.48	<0.500	<0.500
79-01-6	Trichloroethene	5[1]	**168**	**651**	**1,890**	**146 J**	**1,650**	**463**	**71.2**	0.271 J	0.306 J	**7,360**	<0.500	<0.500
75-01-4	Vinyl chloride	2[1]	<0.500	0.571 J	**2.37**	0.524 J	**32.6**	1.11	<0.500	<0.500	<0.500	**6.23**	<0.500	<0.500
SW8151A-Herbicides (ug/L)														
87-86-5	Pentachlorophenol	1[1]	NA	NA	NA	NA	<0.236 UJ	**17 J-**	NA	NA	NA	NA	<0.246 UJ	<0.238 UJ
SW8270C-SVOCs (ug/L)														
117-81-7	bis(2-Ethylhexyl)phthalate	6[1]	NA	NA	NA	NA	<7.22	<6.74	NA	NA	NA	NA	<7.32	<7.90
SW8330-Explosives (ug/L)														
118-96-7	2,4,6-Trinitrotoluene	12[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.574	<0.650	<0.666
121-14-2	2,4-Dinitrotoluene	1.3[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.574	<0.650	<0.666
606-20-2	2,6-Dinitrotoluene	1.3[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.574	<0.650	<0.666

NA= not analyzed
(1) = EPA MCL
(2) = TRRP $^{GW}GW_{Ing}$ PCL
(3) = Shallow/Intermediate classified per 2011 Feasibility Study
Bolded result indicates exceedance of comparison level
mg/L = milligrams per liter
ug/L = micrograms per liter
J = estimated value
J- = estimated value, possibly biased low
J+ = estimated value, possibly biased high
UJ = not detected, level of detection is estimated

Table 4. Monitoring Well Groundwater Sample Statistics

Analyte	Number of Shallow Wells Sampled	Number of Detections in Shallow Wells	Number of Comparison Criteria Exceedances in Shallow Wells	Number of Shallow/Intermediate[(1)] and Upper Intermediate Wells Sampled	Number of Detections in Shallow/Intermediate and Upper Intermediate Wells	Number of Comparison Criteria Exceedances in Shallow/Intermediate and Upper Intermediate Wells	Number of Intermediate Wells Sampled	Number of Detections in Intermediate Wells	Number of Comparison Criteria Exceedances in Intermediate Wells	Detection Range
Perchlorate										
Perchlorate	0	0	0	17	6	3 (47WW11R, LHSMW43R, LHSMW60)	4	1	1 (47WW38)	0.107-38,400 ug/L
Metals										
Aluminum	0	0	0	7	2	0	3	0	0	0.139-0.194 mg/L
Chromium	0	0	0	7	3	1 (47WW14)	3	2	0	0.0112-0.131 mg/L
Cobalt	0	0	0	7	1	0	3	0	0	0.0115 mg/L
Manganese	0	0	0	7	6	0	3	3	1 (47WW19)	0.0328-1.37 mg/L
Nickel	0	0	0	7	4	1 (47WW09)	3	1	0	0.0214- 0.529 mg/L
Silver	0	0	0	7	0	0	3	0	0	NA
Strontium	0	0	0	7	6	0	3	3	0	0.383-3.78 mg/L
Tin	0	0	0	7	1	0	3	0	0	0.439 mg/L
Vanadium	0	0	0	7	0	0	3	0	0	NA
Antimony	0	0	0	7	0	0	3	0	0	NA
Arsenic	0	0	0	7	6	1 (47WW06)	3	3	0	0.00168-0.0262 mg/L
Cadmium	0	0	0	7	0	0	3	0	0	NA
Thallium	0	0	0	7	1	0	3	0	0	0.000112 mg/L
VOCs										
1,1-Dichloroethene	2	2	0	22	10	5 (47WW09, 47WW25R, 47WW42, 47WW45, LHSMW56R)	7	1	1 (47WW34)	0.560-176 ug/L
1,2-Dichloroethane	2	0	0	22	3	0	7	1	0	0.283-4.18 ug/L
Acetone	2	0	0	22	10	0	7	0	0	2.59-12.1 ug/L
Chloroform	2	0	0	22	1	0	7	0	0	1.16 ug/L
cis-1,2-Dichloroethene	2	2	1 (LHSMW45)	22	16	6 (47WW09, 47WW14, 47WW25R, 47WW42, LHSMW43R, LHSMW56R)	7	3	1 (47WW34)	0.304-5,260 ug/L
Tetrachloroethene	2	0	0	22	3	1 (47WW09)	7	0	0	0.763-9.99 ug/L
trans-1,2-Dichloroethene	2	2	0	22	9	0	7	1	0	0.271-56.5 ug/L
Trichloroethene	2	2	2 (LHSMW44, LHSMW45)	22	19	12 (47WW09, 47WW14, 47WW25R, 47WW32, 47WW42, 47WW43, 47WW45, LHSMW41, LHSMW42R, LHSMW43R, LHSMW46R, LHSMW56R)	7	6	4 (LHSMW54, 47WW37, 47WW34, 47WW19)	0.271-120,000 ug/L
Vinyl chloride	2	2	1 (LHSMW45)	22	9	6 (47WW09, 47WW14, 47WW25R, 47WW42, LHSMW43R, LHSMW56R)	7	2	1 (47WW34)	0.253-1,190 ug/L
SVOCs										
bis(2-Ethylhexyl)phthalate	1	0	0	4	0	0	2	0	0	NA
Herbicides										
Pentachlorophenol	1	0	0	4	2	2 (47WW09, LHSMW46R)	2	0	0	17-46.1 ug/L
Explosives										
2,4,6-Trinitrotoluene	0	0	0	7	0	0	0	0	0	NA
2,4-Dinitrotoluene	0	0	0	7	0	0	0	0	0	NA
2,6-Dinitrotoluene	0	0	0	7	0	0	0	0	0	NA

NA: not applicable
(1) = Shallow/Intermediate classified per 2011 Feasibility Study
** indicates result is from duplicate sample*

A

Soil Boring Logs

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Borehole Log

Site: LHAAP	**Boring Number: 47WW08R**	**Soil Boring: 47WW08R**	**Monitoring Well: 47WW08R**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Diedrich D-50	**Date/Time Started/Finished: 06/15/2018 (0900-1200)**	**Completed Depth (feet): 39.5' bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25"**	**Groundwater Depth (feet): ~23' bgs**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4" ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 39.5' bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2	Clay, silty, red brown (2.5YR 3/4), soft, dry, low plasticity, soft	CL	-	-	1.5/2	-	-	
2-19	Clay, pale brown (10YR 6/3), very stiff, dry, non-plastic, hard; intermittent fine sand at 11' bgs	CL	-	-	9/17	-	-	
19-25	Silt, clayey, yellow/brown (10YR 5/4), moist, low plasticity, moderate stiff, trace fine sand	ML	-	-	2/6	-	-	Wet at 23' bgs
25-26	Clay, light gray (10YR 7/1), very stiff, moist, medium plasticity	CL	-	-	1/1	-	-	
26-35	Silt, clayey, yellow/brown (10YR 5/4), wet, medium plasticity, soft, some sand at 29' bgs	ML	-	-	7/9	-	-	
35-39.5	Silt, sandy, yellow/brown (10YR 5/4), soft, wet, non-plastic	ML	-	-	3/4.5	-	-	
								After boring completed, installed replacement monitoring well 47WW08R here

00916070

Borehole Log

Site: LHAAP	Boring Number: 47WW11R	Soil Boring: 47WW11R	Monitoring Well: 47WW11R
Project Name: LHAAP-47 PSI		Project Number: 10097916	
Drilling Equipment: CME 55	Date/Time Started/Finished: 06/06/2018 (0900-1200)	Completed Depth (feet): 35′ bgs	
Drilling Contractor: ETTL	Borehole Diameter (in): 10.25”	Groundwater Depth (feet): ~25′ bgs	
Driller: Rich Herman	Type/Diameter Casing: Sch. 40 / 4” ID	Sampling Method: NA	
Drilling Method: HSA	Installation Depth: 35′ bgs	Logged By: Jacob Ruffing	
Drilling Fluid: NA	Grout Type/Volume: Portland gel / NA	Abandoned: Y N Backfill Material: NA	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-4	Silty clay/clayey silt, light brown, reddish-brown, orange-brown, and yellowish-orange (mottled and stained), trace to some fine sand, dry to slightly damp, stiff	CL	0	200	3.5/4	-	-	0-19′ logged from original 08/04/1998 boring log for 47WW11
4-9	Silty clay, yellow gray, tan, brown, yellowish-orange mottled, streaked and stained, trace black root-like structures, trace to some fine sand, damp to moist, very stiff, no visible water	CL	200	200	5/5	-	-	
9-15.5	Silty clay, light gray, greenish, gray, tan, brown, yellowish-orange and rust brown mottled/stained, very thin horizontal layering, trace to some fine sand throughout, very plastic, most, very stiff to stiff	CL	0	500	6.5/6.5	-	-	
15.5-17	Silty sand, light gray, tan, yellowish-orange mottled/stained, fine grain sand, trace to some silt, poorly graded, wet, loose	SP	0	0	1.5/1.5	-	-	
17-17.5	Silty sand, light gray and tan, mottled, fine grain sand, moist to wet, loose	SM	0	0	0.5/0.5	-	-	
17.5-19	Silty clay, light gray, green, mottled, trace to some fine sand, moist, stiff	CL	0	0	1.5/1.5	-	-	
19-20	-	-	-	-	-	-		
20-24	Clay, yellow/brown (10YR 5/4), gray mottling (10YR 6/1), moist, medium stiffness, low plasticity	CL	-	-	2/4	-	-	
24-30	Silt, sandy with interbedded clay, yellow/ brown with gray mottling, soft, moist, non-plastic	ML	-	-	3/6	-	-	Wet at 25′ bgs
30-35	Sand, silty, dark yellow/brown (10YR 4/4), soft, wet	SM	-	-	2.5/5	-	-	
								After boring completed, installed replacement monitoring well 47WW11R here

Borehole Log

Site: LHAAP	**Boring Number: 47WW25R**	**Soil Boring: 47WW25R**	**Monitoring Well: 47WW25R**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: CME 55	**Date/Time Started/Finished: 06/01/2018 (0930-1300)**	**Completed Depth (feet): 40' bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25"**	**Groundwater Depth (feet): ~31' bgs**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4" ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 40' bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-4	Silty clay, light gray, tan-brown and orange-brown mottled, streaked and stained, trace roots, trace fine sand, moist, stiff	CL	0	0	3.1/4	-	-	0-25' logged from original 12/02/2000 boring log for 47WW25
4-9	Silty clay, light gray, orange-brown and red-brown mottled, streaked and stained, trace to some fine sand throughout, moist, very stiff	CL	200	0	4.8/5	-	-	
9-14	Silty clay, light gray, yellow-brown and orange-brown mottled, horizontal layering with black streaking and staining, trace to some fine sand throughout, moist, very stiff	CL	100	0	5/5	-	-	
14-22	Silty clay, light gray, yellow brown mottled, trace to some fine sand throughout, some layering, moist, very stiff	CL	300	0	8/8	-	-	
22-23	Sand, light gray with tan mottling, very fine to fine grained, poorly sorted, wet/saturated, loose	SP	0	0	1/1	-	-	
23-25	Silty sand, light gray and orange-brown mottled, very fi ne to fine grained sand, wet/saturated, loose	SM	0	0	2/2	-	-	
25-34	Clay, silty, light brown/gray (10YR 6/2), moist, low plasticity, soft	CL	-	-	7/9	-	-	
34-40	Silt, sandy, brown (10YR 4/3), fine sand, moist, non-plastic, stiff	ML	-	-	1/6	-	-	
								After boring completed, installed replacement monitoring well 47WW25R here

00916072

Borehole Log

Site: LHAAP	**Boring Number: 47WW26R**	**Soil Boring: 47WW26R**	**Monitoring Well: 47WW26R**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: CME 55	**Date/Time Started/Finished: 06/11/2018 (1200) - 06/12/18 (1100)**	**Completed Depth (feet): 40' bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25"**	**Groundwater Depth (feet): -**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4" ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 40' bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2	Clay, dark red (2.5R 3/4), very stiff, low plasticity, dry	CL	-	-	1.5/2	-	-	
2-4	Clay, silty, dark yellow/brown (10YR 4/4), very stiff, non-plastic , dry	CL	-	-	2/2	-	-	
4-40	Clay, same as above, gray (10YR 6/1) with brown/yellow mottling (10YR 6/4)	CL	-	-	31/36	-	-	
								This is boring that is nearest to SB-10i, which the Geoprobe was unable to sample since the clay was so stiff and solid. Initial borehole location for 47WW26R install was all clay; consulted with USACE to determine another location in hopes of finding better producing zone. Second boring location initially produced no water; let sit overnight and it produced some water. Consulted with USACE whether to install well, since it will likely be a poor producer. Went ahead and installed.

Borehole Log

Site: LHAAP	**Boring Number: 47WW39**	**Soil Boring: NewWell1**	**Monitoring Well: 47WW39**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: CME 55	**Date/Time Started/Finished: 05/29/2018 (0800) - 05/30/2018 (1000)**	**Completed Depth (feet): 40′ bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25”**	**Groundwater Depth (feet): ~20′ bgs**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4” ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 40’ bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 25 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-4	Clay, brown (10YR 5/3), very stiff, low plasticity, dry	CL	-	-	3.5/4	-	-	
4-14	Clay, mottled with light brown/gray (10YR 6/2), organics	CL	-	-	5.5/10	-	-	
14-20	Sand, fine, brown/yellow (10YR 6/6), dry, loose	SM	-	-	3/6	-	-	Wet at 20’ bgs
20-31	Clay, sandy, brown/yellow (10YR 6/6), wet, very soft, low plasticity	CL	-	-	8/11	-	-	
31-39	Sand, fine, light yellow/brown (10YR 6/4), wet, loose	SM	-	-	5.5/8	-	-	
39-40	Clay, light brown/gray (10YR 6/2), moist, very stiff, low plasticity	CL	-	-	1/1	-	-	
								After boring completed, installed monitoring well 47WW39 here

Borehole Log

Site: LHAAP	**Boring Number: SB-03**	**Soil Boring: SB-03**	**Monitoring Well: 47WW40**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Geoprobe 7720DT	**Date/Time Started/Finished: 05/29/2018 (1025-1500)**	**Completed Depth (feet): 40′ bgs**	
Drilling Contractor: PPD	**Borehole Diameter (in): 2.25" / 10.25"**	**Groundwater Depth (feet): ~20′ bgs**	
Driller: Billy Carroll	**Type/Diameter Casing: NA**	**Sampling Method: Bailer**	
Drilling Method: DPT	**Installation Depth: 40′ bgs**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 8 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2	Sand, dry, loose, red/brown	SM	0	0	2	-	-	
2-7	Clay, silty, gray/red/brown, stiff, dry	CL	0	0	5	-	-	
7-9	Silt, dry, stiff, gray/brown	ML	0	0	2	-	-	
9-10.5	Sand, loose, dry, gray/brown	SM	0	0	1.5	-	-	
10.5-22	Silt, stiff, dry, clayey, brown/red/gray, very compact	ML	0	0	11.5	-	-	
22-30	Sand, fine grain, brown, loose	SM	0	0	8	295SB03A	1215	Wet at 24′ Water level ~19.7′ bgs; screened interval 19.6-24.6′ bgs Collect MS/MSD on this sample
30-40	SAA, saturated	SM	0	0	10	295SB03B	1420	Water level ~20.1′ bgs; screened interval 32.7-37.7′ bgs
								After boring completed, monitoring well 47WW40 was installed at this location at a later date

00916075

Borehole Log

Site: LHAAP	**Boring Number: SB-04**	**Soil Boring: SB-04**	**Monitoring Well: 47WW41**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Geoprobe 7720DT	**Date/Time Started/Finished: 05/29/2018 (1515-1610)**	**Completed Depth (feet): 38' bgs**	
Drilling Contractor: PPD	**Borehole Diameter (in): 2.25"**	**Groundwater Depth (feet): ~23' bgs**	
Driller: Billy Carroll	**Type/Diameter Casing: NA**	**Sampling Method: Bailer**	
Drilling Method: DPT	**Installation Depth: 38' bgs**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 12.5 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2	Sand, loose, dry, red, silty, fine grain	SM	0	0	1	-	-	
2-4	Clay, moist, sandy and silty, red, plastic	CL	0	0	2	-	-	
4-19	Silt/sand, dry, gray/red, stiff	ML/SM	0	0	15	-	-	
19-22	Clay, silty, moist, stiff, gray/red	CL	0	0	3	-	-	
22-28	Sand, clayey, moist, gray/red	SM	0	0	6	305SB04A 305DUP01	0815 1600	Water level 23.35' bgs; screened interval 22.8-27.8' bgs
28-38	Clay, stiff, moist, plastic, gray/red	CL	0	0	10			Refusal at 38' bgs
								Hole did not have water on first drive, but set casing at most likely water zone and let sit overnight. Hole had water next morning. After boring completed, monitoring well 47WW41 was installed at this location at a later date

00916076

Borehole Log

Site: LHAAP	**Boring Number: SB-05**	**Soil Boring: SB-05**	**Monitoring Well: 47WW42**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Geoprobe 7720DT	**Date/Time Started/Finished: 05/30/2018 (1025-1310)**	**Completed Depth (feet): 40' bgs**	
Drilling Contractor: PPD	**Borehole Diameter (in): 2.25"**	**Groundwater Depth (feet): ~18' bgs**	
Driller: Billy Carroll	**Type/Diameter Casing: NA**	**Sampling Method: Bailer**	
Drilling Method: DPT	**Installation Depth: 40' bgs**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 7.5 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-3	Sand, silty/clayey, loose at top, dry, red/brown	SM	0	0	2	-	-	
3-11	Intermixed clay and silt, gray/red, stiff, hard,	CL/ML	200-400 across 5-10' bgs 2,000 at 11' bgs	0	8	-	-	
11-21	Intermixed sand and clay, gray/red, stiff	SM/CL	200-9,000	0	10	-	-	Wet zones at 15' and 18' bgs
21-28	Sand, loose, wet, red	SM	Up to 10,000 across core	0	7	305SB05A	1125	Saturated at 25' bgs Water level 17.98' bgs; screened interval 21-26' bgs
28-40	Sand, saturated, brown/gray, loose	SM	Up to 2,000 across core	0	12	305SB05B	1225	Water level 18.25' bgs; screened interval 30.5-35.5' bgs
								After boring completed, monitoring well 47WW42 was installed at this location at a later date

Borehole Log

Site: LHAAP	**Boring Number: SB-06**	**Soil Boring: SB-06**	**Monitoring Well: 47WW43**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Geoprobe 54DT / CME 55	**Date/Time Started/Finished: 05/22/2018 (1510-1600), 05/24/2018 (1355-1645)**	**Completed Depth (feet): 40′ bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 2.25" / 8.25"**	**Groundwater Depth (feet): ~23′ bgs**	
Driller: Pedro Gonzalez / Rich Herman	**Type/Diameter Casing: NA**	**Sampling Method: Bailer**	
Drilling Method: DPT / HSA	**Installation Depth: 40′ bgs**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 80 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-5	Clay, silty, very stiff	CL	0.7 @ 1′ bgs	0	5	-	-	Refusal at 5′ bgs with Geoprobe, resume drilling 05/24/2018 with CME 55
5-10	Silt with sandy zone 5-7′ bgs, stiff, clayey 7-10′ bgs, dry, gray/red, mottled	ML	0	0	4.5	-	-	
10-13	Silt, loose, sandy	ML	0	0	1	-	-	
13-14	Clay, dry, hard	CL	0	0	1	-	-	
14-25	Sand, white/red, loose	SM	0.2-0.67	0	7.5	255SB06A 245DUP01	0800 1200	Wet at 24′ bgs Water level 22.7′ bgs; screened interval 19.7-24.7′ bgs
25-27	Clay, wet, plastic, stiff	CL	0	0	2	-	-	
27-30	Silt, clayey, wet, stiff	ML	0	0	3	-	-	
30-32	Clay, fat, wet, mottled	CL	0	0	2	-	-	
32-35	Silt, stiff, dry	ML	0	0	3	-	-	
35-37	Clay, silty, wet	CL	0	0	2	-	-	
37-40	Clay, silty, dark brown to black, very dry and crumbly, shale-like	CL	0	0	3	-	-	
								Originally set screen 25.2-30.2′ bgs after seeing wet core, but hole did not produce water. Set screen again from 30-35′ bgs, but still no water. Decided to move over and run auger flights to 25′ bgs and leave hole overnight to see if it produces water. After boring completed, monitoring well 47WW43 was installed at this location at a later date

Borehole Log

Site: LHAAP	**Boring Number: 47WW44**	**Soil Boring: NewWell2**	**Monitoring Well: 47WW44**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Diedrich D-50 / Geoprobe 6600	**Date/Time Started/Finished: 06/19/2018 (1300) – 08/20/2018 (1150)**	**Completed Depth (feet): 60' bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25" / 2.25"**	**Groundwater Depth (feet): ~24' bgs**	
Driller: Rich Herman	**Type/Diameter Casing: NA**	**Sampling Method: NA**	
Drilling Method: HSA / DPT	**Installation Depth: 60' bgs**	**Logged By: Jacob Ruffing / Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2	Silt, dark yellow/brown (10YR 4/6), dry, very soft, low plasticity	ML	-	-	1.5/2	-	-	
2-4	Clay, silty, pale brown (10YR 6/3), dry, stiff, low plasticity	CL	-	-	1.5/2	-	-	
4-20	Clay, yellow/red (5YR 4/6), pale brown mottling (10YR 6/3), hard, dry, low plasticity	CL	-	-	2/6	-	-	
20-24	Clay, gray with red mottling, silty, plastic, stiff	CL	-	-	3.5/4	-	-	
24-30	Intermixed sand and clay, wet, brown, very plastic	SC/CL	-	-	4.5/6	-	-	Wet at ~24' bgs
30-33	Sand, wet, loose, brown, fine grain	SM	-	-	0.5/3	-	-	
33-34	Clay, brown, very stiff, plastic, moist	CL	-	-	1/1	-	-	
34-60	Sand, loose, fine to coarse grain, brown/gray, wet, gravel at 58' bgs	SM	-	-	19.5/26	-	-	Refusal at 60' bgs
								After boring completed, monitoring well 47WW44 was installed at this location at a later date

00916079

Borehole Log

Site: LHAAP	**Boring Number: SB-07i**	**Soil Boring: SB-07i**	**Monitoring Well: 47WW45**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: **CME 55 / Geoprobe 7720DT**	**Date/Time Started/Finished:** **OSI casing install to 22' bgs: 05/17/2018 (0840-0920)** **DPT drilling: 06/05/2018 (1100-1700); 06/06/2018 (0840-1100)**	**Completed Depth (feet): 60' bgs**	
Drilling Contractor: ETTL / PPD	**Borehole Diameter (in): 6.25" / 2.25"**	**Groundwater Depth (feet): 20-32' bgs**	
Driller: Rich Herman / Billy Carroll	**Type/Diameter Casing: 4" Sch. 40 PVC**	**Sampling Method: Bailer**	
Drilling Method: Flight auger / DPT	**Installation Depth: 60' bgs**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 80 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-5	Clay, sandy	CL	-	-	-	-	-	
5-10	Clay, SAA	CL	-	-	-	-	-	
10-15	Clay, very moist, very plastic	CL	-	-	-	-	-	
15-20	Wet sand and clay	SM/CL	-	-	-	-	-	Wet material, estimated water level ~18' bgs
20-22	Stiff, hard clay	CL	-	-	-	-	-	Set surface casing at 22' bgs on 05/17/2018
22-28	Clay, intermixed sand, gray/red, wet	CL	600-2,000 across core	0	5	-	-	
28-32	Sand, wet, loose, gray/red	SM	Up to 8,000 across core	0	4	-	-	
32-42	SAA	SM	800 from 32-34' bgs 350 from 34-36' bgs 200 from 36-42' bgs	0	10	-	-	
42-46	Sand, coarse grain, wet, loose	SM	700 from 42-44' bgs 1,300 from 44-46' bgs	0	4	056SB07iA	1640	Coarse sand locked up rods at 46' bgs. Had to pull entire drill string and push disposable tip back to depth. Water level 32.2' bgs; screened interval 42.2-47.2' bgs
46-60	-	-	-	-	-	066SB07iB	1000	Pushed disposable tip to refusal at 60' bgs. Did not want to push sampling rods and lock them up again. Water level 20.6' bgs; screened interval 54.2-59.2' bgs After boring completed, monitoring well 47WW45 was installed at this location at a later date

Borehole Log

Site: LHAAP	**Boring Number: SB-07i2**	**Soil Boring: SB-07i2**	**Monitoring Well: 47WW46**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Geoprobe 6600	**Date/Time Started/Finished: 08/08/2018 (1400) – 08/21/2018 (0900)**	**Completed Depth (feet): 55′ bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 2.25”**	**Groundwater Depth (feet): ~20′ bgs**	
Driller: Rich Herman	**Type/Diameter Casing: NA**	**Sampling Method: NA**	
Drilling Method: DPT	**Installation Depth: 55’ bgs**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-5	Clay/silt, stiff, dry, red mottling, fray/brown	CL/ML	-	-	4/5	-	-	
5-19	Clay, stiff, moist, very plastic, red mottling	CL	-	-	14/14	-	-	
19-23.5	Sand, brown/gray, red mottling, silty, fine grain, saturated from 20-23.5’ bgs	SM	-	-	4.5/4.5	-	-	Wet at ~20’ bgs
23.5-35	Clay, stiff, plastic, moist, gray/brown with red mottling	CL	-	-	7/11.5	-	-	
35-55	Sand, saturated, brown/red, fine to coarse grain, loose	SM	-	-	16/20	-	-	Refusal at 55’ bgs
								After boring completed, monitoring well 47WW46 was installed at this location at a later date

Borehole Log

Site: LHAAP	**Boring Number: SB-08i**	**Soil Boring: SB-08i**	**Monitoring Well: 47WW47**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: **CME 55 / Geoprobe 7720DT**	**Date/Time Started/Finished:** **OSI casing install to 24' bgs: 05/16/2018 (1430-1745)** **DPT drilling: 06/01/2018 (0955-1345)**	**Completed Depth (feet): 63' bgs**	
Drilling Contractor: ETTL / PPD	**Borehole Diameter (in): 6.25" / 2.25"**	**Groundwater Depth (feet): 44-48' bgs**	
Driller: Rich Herman / Billy Carroll	**Type/Diameter Casing: 4" Sch. 40 PVC**	**Sampling Method: Bailer**	
Drilling Method: Flight auger / DPT	**Installation Depth: 63' bgs**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 115 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-7	Clay, stiff, highly plastic, moist	SM	-	-	-	-	-	
7-10	Silty sand with gravel	SM	-	-	-	-	-	
10-16	Clay, silty, plastic, slightly moist	CL	-	-	-	-	-	
16-22	Silty sand	SM	-	-	-	-	-	Wet material ~20' bgs
22-24	Clay, stiff, hard, moist	CL	-	-	-	-	-	Set surface casing at 24' bgs on 05/16/2018
24-50	Sand, wet, loose, gray/brown/red, clay lenses at 31' and 37' bgs	SM	0	0	16	016SB08iA	1130	Water level 44' bgs; screened interval 42.5-47.5' bgs
50-53	SAA, wet, more clay content	SM	0	0	2	-	-	
53-63	Clay, sandy, brown, wet, stiff	CL	0	0	10	016SB08iB	1245	Refusal at 63' bgs Water level 48.5' bgs; screened interval 56.2-61.2' bgs After boring completed, monitoring well 47WW47 was installed at this location at a later date

00916082

Borehole Log

Site: LHAAP	**Boring Number: LHSMW42R**	**Soil Boring: LHSMW42R**	**Monitoring Well: LHSMW42R**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Diedrich D-50	**Date/Time Started/Finished: 06/14/2018 (1300-1650)**	**Completed Depth (feet): 39.5' bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25"**	**Groundwater Depth (feet): ~27' bgs**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4" ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 39.5' bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2	Clay, dark yellow/brown (10YR 4/4), medium stiffness, medium plasticity, moist	CL	-	-	2/2	-	-	
2-10	Clay, gray brown (10YR 5/2), high plasticity, moist, stiff	CL	-	-	8/8	-	-	
10-16	Clay, silty, yellow/brown (10YR 5/4), medium stiffness, medium plasticity, moist	CL	-	-	1/6	-	-	
16-18	Sand, silty, yellow/brown (10YR 5/4), loose, dry, very fine, well graded	SM	-	-	1/1	-	-	
18-20	Clay, silty, gray (10YR 6/1), moist, medium plasticity, stiff	CL	-	-	2/2	-	-	
20-27	Silt, clayey, gray (10YR 6/1), dry, non-plastic, medium stiffness	ML	-	-	3/7	-	-	
27-39.5	Sand, silty, yellow/brown (10YR 5/4), loose, well graded	SM	-	-	2/12.5	-	-	Wet at 27' bgs.
								After boring completed, installed replacement monitoring well LHSMW42R here

Borehole Log

Site: LHAAP	**Boring Number: LHSMW43R**	**Soil Boring: LHSMW43R**	**Monitoring Well: LHSMW43R**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: CME 55	**Date/Time Started/Finished: 05/30/2018 (1500) – 05/31/2018 (1000)**	**Completed Depth (feet): 35′ bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25”**	**Groundwater Depth (feet): ~24′ bgs**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4” ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 34′ bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-5	Silt with sand, brown, moist	ML	-	-	-	-	-	0-19.5′ logged from original 09/00/1994 boring log for LHSMW43
5-7	Lean clay, grayish brown, damp to moist	CL	-	-	-	-	-	
7-9	Lean clay with sand, brown, damp	CL	-	-	-	-	-	
9-11	Lean clay, gray, moist	CL	-	-	-	-	-	
11-13	Lean clay with sand, brown to gray, moist to very moist	CL	-	-	-	-	-	
13-16	Silty sand, brown, wet to free water	SM	-	-	-	-	-	
16-19.5	Lean clay with sand, brown, moist	CL	-	-	-	-	-	
19.5-35	Silt, sandy (fine grain), brown (10YR 5/3), very soft, moist, non-plastic	ML	-	-	5/15.5	-	-	
								After boring completed, installed replacement monitoring well LHSMW43R here

Borehole Log

Site: LHAAP	**Boring Number: LHSMW46R**	**Soil Boring: LHSMW46R**	**Monitoring Well: LHSMW46R**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: CME 55	**Date/Time Started/Finished: 05/31/2018 (1200-1600)**	**Completed Depth (feet): 40′ bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25”**	**Groundwater Depth (feet): ~30′ bgs**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4” ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 40’ bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2	Lean clay with sand, brown, moist	CL	-	-	-	-	-	0-15′ logged from original 09/00/1994 boring log for LHSMW46
2-7	Lean clay with sand, orange-brown and gray, moist to very moist	CL	-	-	-	-	-	
7-8	Lean clay, sandy, grayish brown, moist	CL	-	-	-	-	-	
8-9	Silty sand, brown and gray, moist	SM	-	-	-	-	-	
9-13	Lean clay with sand, brown and gray, moist	CL	-	-	-	-	-	
13-15	Silty sand, brown, wet	SM	-	-	-	-	-	
15-35	Clay, silty, light brown/gray (10YR 6/2), yellow/brown mottling (10YR 5/4), low plasticity, dry, sandy at 34.5’ bgs	CL	-	-	10/20	-	-	
35-40	Sand, silty, yellow/brown (10YR 5/4), very loose, wet	SM	-	-	1/6	-	-	Wet at 30’ bgs
								After boring completed, installed replacement monitoring well LHSMW46R here

Borehole Log

Site: LHAAP	**Boring Number: LHSMW55R**	**Soil Boring: LHSMW55R**	**Monitoring Well: LHSMW55R**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: CME 55	**Date/Time Started/Finished: 06/07/2018 (1200-1630)**	**Completed Depth (feet): 35.5' bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25"**	**Groundwater Depth (feet): ~22' bgs**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4" ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 35.5' bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2	Clay sand, reddish brown, moist	SC	-	-	-	-	-	0-15' logged from original 09/00/1994 boring log for LHSMW55
2-4.5	Lean clay, sandy, brown, very moist	CL	-	-	-	-	-	
4.5-9.3	Fat clay, grayish brown, moist	CH	-	-	-	-	-	
9.3-11	Lean clay, grayish brown, moist	CL	-	-	-	-	-	
11-13	Fat clay, grayish brown, moist	CH	-	-	-	-	-	
13-15	Silt sand, light gray, free water	SM	-	-	-	-	-	
15-25	Silt, sandy, yellow/brown (10YR 5/4), gray mottling (10YR 6/1), very soft, non-plastic, dry	ML	-	-	3.5/10	-	-	Wet at 20' bgs
25-35	Sand, silty, yellow/brown, 10YR 5/4), wet, very loose, well sorted	SM	-	-	6/10	-	-	
35-35.5	Silt, clayey, gray (10YR 6/1), medium stiffness, non-plastic, wet	ML	-	-	0.5/0.5	-	-	
								After boring completed, installed replacement monitoring well LHSMW55R here

00916086

Borehole Log

Site: LHAAP	**Boring Number: LHSMW56R**	**Soil Boring: LHSMW56R**	**Monitoring Well: LHSMW56R**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: CME 55	**Date/Time Started/Finished: 06/06/2018 (1430) – 06/07/2018 (1015)**	**Completed Depth (feet): 35′ bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 10.25”**	**Groundwater Depth (feet): ~28′ bgs**	
Driller: Rich Herman	**Type/Diameter Casing: Sch. 40 / 4” ID**	**Sampling Method: NA**	
Drilling Method: HSA	**Installation Depth: 35’ bgs**	**Logged By: Jacob Ruffing**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / NA**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-3	Clay sand, reddish brown, moist	SC	-	-	-	-	-	0-20′ logged from original 09/22/1994 boring log for LHSMW56
3-5.7	Lean clay, silty with sand, brown, moist	CL/ML	-	-	-	-	-	
5.7-11	Lean clay with sand, brown to grayish brown, moist	CL	-	-	-	-	-	
11-14	Fat clay, brown, moist	CH	-	-	-	-	-	
14-16.5	Silt sand, brown, free water	SM	-	-	-	-	-	
16.5-18.5	Sand silt, brown, wet	SM	-	-	-	-	-	
18.5-20	Lean clay, grayish brown, very moist	CL	-	-	-	-	-	
20-25	Clay, silty, yellow/brown (10YR 5/4), gray mottling (10YR 6/1), medium stiffness, moist, high plasticity	CL	-	-	3.5/5	-	-	
25-30	Silt, sandy, some clay content, yellow/brown (10YR 6/1); silt is very soft and non-plastic; clay is stiff, wet, and has high plasticity	ML	-	-	1/5	-	-	Wet at 28′ bgs
30-35	Clay, silty, gray (10YR 6/1), soft with very stiff sections, low to high plasticity, wet	CL	-	-	3/5	-	-	
								After boring completed, installed replacement monitoring well LHSMW56R here

Borehole Log

Site: LHAAP	**Boring Number: SB-01**	**Soil Boring: SB-01**	**Monitoring Well: NA**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Geoprobe 54DT / CME 55	**Date/Time Started/Finished: 05/22/2018 (1200-1300), 05/23/2018 (1200-1420)**	**Completed Depth (feet): 35.2′ bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 2.25" / 8.25"**	**Groundwater Depth (feet): ~30′ bgs**	
Driller: Pedro Gonzalez / Rich Herman	**Type/Diameter Casing: NA**	**Sampling Method: Bailer**	
Drilling Method: DPT / HSA	**Installation Depth: NA**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 100 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-2.5	Sand, silty and clayey; brown/red	SM	0	0	2.5	-	-	
2.5-5	Clay, stiff, plastic, gray/red	CL	9.3 @ 5′	0	2.5	-	-	
5-15	SAA, very stiff, silty, dry to slightly moist, gray/red, mottled	CL	0	0	10	-	-	Refusal at 12′ bgs with Geoprobe, resume drilling next day with CME 55
15-20	Clay, very silty, loose/crumbly 15-17′ bgs, very stiff 17-20′ bgs	CL	0	0	5	-	-	
20-21	Sand, silty, dry, gray/red	SM	0	0	1	-	-	
21-25	Clay, stiff, fat, moist, gray/red	CL	0	0	4	-	-	
25-29	Clay, silty, loose, gray/red, mottled	CL	0	0	4	-	-	
29-31	Sand, silty, wet, brown/red	SM	0	0	2	-	-	Water level ~30′ bgs
31-35	Clay, silty, 1-2" sandy/gravelly zones, wet, plastic	CL	0	0	4	235SB01A	1450	Screened interval 30.2-35.2′ bgs

Borehole Log

Site: LHAAP	**Boring Number: SB-02**	**Soil Boring: SB-02**	**Monitoring Well: NA**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: Geoprobe 54DT / CME 55	**Date/Time Started/Finished: 05/22/2018 (1335-1445), 05/24/2018 (0800-1210)**	**Completed Depth (feet): 40′ bgs**	
Drilling Contractor: ETTL	**Borehole Diameter (in): 2.25" / 8.25"**	**Groundwater Depth (feet): ~27-29′ bgs**	
Driller: Pedro Gonzalez / Rich Herman	**Type/Diameter Casing: NA**	**Sampling Method: Bailer**	
Drilling Method: DPT / HSA	**Installation Depth: NA**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 115 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb):	Recovered Length (feet)	Sample Number	Sample Time	
0-10	Clay, stiff, slightly moist, silty	CL	0	0	10	-	-	Refusal at 10′ bgs with Geoprobe, resume drilling 05/24/2018 with CME 55
10-15	Clay, silty, stiff, hard, dry, non-plastic, gray with red mottling, 4" sand lense at 11′ bgs, dark organic stains	CL	0	0	5	-	-	
15-18	Sand, silty, fine grain, red iron mottling, damp	SM	0.2	0	2	-	-	
18-20	Silt with clay and sand, hard, stiff, gray/red, mottled	ML	0	0	2	-	-	
20-25	Sand, silty with clay, moist, gray/red, plastic, loose	SM	0	0	3	-	-	
25-28.5	Silt, sandy with high clay content	ML	0	0	3.5	-	-	
28.5-30	Sand, Silty, wet, loose, plastic, clayey	SM	0	0	1.5	245SB02A	0940	Water level 26.7′ bgs; screened interval 25.4-30.4′ bgs
30-35	Sand, silty with clay, wet, loose, brown/gray/red	SM	0.2	0	2.5	-	-	
35-40	Sand, saturated, gray/red, silty and clayey	SM	0	0	3	245SB02B	1150	Water level 29′ bgs; screened interval 34.6-39.6′ bgs

Borehole Log

Site: LHAAP	**Boring Number: SB-09i**	**Soil Boring: SB-09i**	**Monitoring Well: NA**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: **CME 55 / Geoprobe 7720DT**	**Date/Time Started/Finished:** **OSI casing install to 21' bgs: 05/15/2018 (0950-1305)** **DPT drilling: 06/04/2018 (1345-1740)**	**Completed Depth (feet): 44' bgs**	
Drilling Contractor: ETTL / PPD	**Borehole Diameter (in): 10.25" / 2.25"**	**Groundwater Depth (feet): ~38' bgs**	
Driller: Rich Herman / Billy Carroll	**Type/Diameter Casing: 4" Sch. 40 PVC**	**Sampling Method: Bailer**	
Drilling Method: HSA / DPT	**Installation Depth: NA**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 120 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-15	Silty clay	CL	-	-	-	-	-	Slight unfamiliar odor; driller says smells like landfill; no visual signs of contamination
15-19	Silty sand	SM	-	-	-	-	-	Wet
19-20	Clay	CL	-	-	-	-	-	Set surface casing at 21' bgs on 05/15/2018
20-37	Clay, sandy/silty, wet, very plastic, gray/red	CL	0	0	17	-	-	Very wet at 34' bgs
37-40	Sand, small gravel, red, loose, wet	SM	0	0	3	-	-	
40-43	Clay, hard, compact, silty, black	CL	0	0	3	-	-	
43-44	Sand, hard, silty, black	SM	0	0	1	046SB09iA	1600	Refusal at 44' bgs Water level 38.3' bgs; screened interval 39.7-44.7' bgs

Borehole Log

Site: LHAAP	**Boring Number: SB-10i**	**Soil Boring: SB-10i**	**Monitoring Well: NA**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: **CME 55 / Geoprobe 7720DT**	**Date/Time Started/Finished:** **OSI casing install to 22' bgs: 05/16/2018 (0745-0920)** **DPT drilling: 05/30/2018 (1340-1600)**	**Completed Depth (feet): 36' bgs**	
Drilling Contractor: ETTL / PPD	**Borehole Diameter (in): 6.25" / 2.25"**	**Groundwater Depth (feet): NA**	
Driller: Rich Herman / Billy Carroll	**Type/Diameter Casing: 4" Sch. 40 PVC**	**Sampling Method: NA**	
Drilling Method: Flight auger / DPT	**Installation Depth: NA**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 70 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-15	Silty clay	CL	-	-	-	-	-	
15-18	Silty sand	SM	-	-	-	-	-	
18-22	Clay	CL	-	-	-	-	-	Set surface casing at 22' bgs on 05/16/2018
22-36	Clay, stiff, moist, plastic, black/gray/red	CL	0	0	14	-	-	Refusal at 36' bgs, no water, abandon hole

Borehole Log

Site: LHAAP	**Boring Number: SB-11i**	**Soil Boring: SB-11i**	**Monitoring Well: NA**
Project Name: LHAAP-47 PSI		**Project Number: 10097916**	
Drilling Equipment: **CME 55 / Geoprobe 7720DT**	**Date/Time Started/Finished:** **OSI casing install to 35.5' bgs: 05/16/2018 (0920-1430)** **DPT drilling: 06/04/2018 (0920-1345)**	**Completed Depth (feet): 55' bgs**	
Drilling Contractor: ETTL / PPD	**Borehole Diameter (in):** **6.25" / 10.25" / 2.25"**	**Groundwater Depth (feet): 26-45' bgs**	
Driller: Rich Herman / Billy Carroll	**Type/Diameter Casing: 4" Sch. 40 PVC**	**Sampling Method: Bailer**	
Drilling Method: Flight auger / HSA / DPT	**Installation Depth: NA**	**Logged By: Eric North**	
Drilling Fluid: NA	**Grout Type/Volume: Portland gel / 230 gal.**	**Abandoned: Y N Backfill Material: NA**	

Depth (feet)	USCS Lithologic Description	USCS Type	Samples					Remarks (sample number, odor, etc.)
			PID (ppb) Headspace	Ambient PID (ppb)	Recovered Length (feet)	Sample Number	Sample Time	
0-14	Silty sand	SM	-	-	-	-	-	
15-17	Clay	CL	-	-	-	-	-	
17-34	Silty sand	SM	-	-	-	-	-	Water at ~31' bgs; convert to HSA at 32'
34-35	Clay	CL	-	-	-	-	-	Set surface casing at 35.5' bgs on 05/16/2018
35-41	Clay, stiff, silty, plastic, moist, gray/red	CL	0	0	6	-	-	
41-48	Sand, wet, gray/red, loose	SM	0	0	7	046SB11iA	1105	Water level 26.05' bgs; screened interval 41.4-46.4' bgs
48-54	SAA	SM	0	0	6	046SB11iB	1145	Water level 45.1' bgs; screened interval 47.6-52.6' bgs
54-55	Silt, hard, compact, dry, dark brown	ML	0	0	0.5	-	-	Refusal at 55' bgs

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B

Well Completion Forms

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00916095

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW08R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 41.86'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 06/15/2018 TIME: 0900
WELL INSTALLATION BEGAN:
DATE: 06/15/2018 TIME: 1200
WELL INSTALLATION FINISHED:
DATE: 06/15/2018 TIME: 1400
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: Diedrich D-50
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~32'

WELL SCREEN

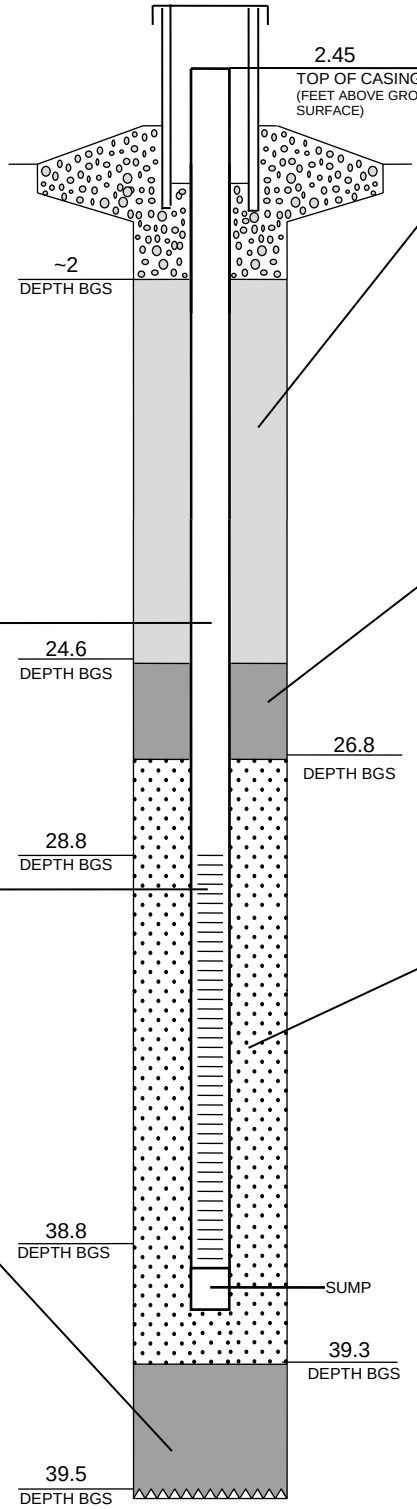
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 195.06
GROUND SURFACE ELEVATION: 192.6
NORTHING: 6960984.713
EASTING: 3309381.553
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: -
BENTONITE: -
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: -
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: -
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 28.14'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916096

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW11R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 37.71'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 06/06/2018 TIME: 0900
WELL INSTALLATION BEGAN:
DATE: 06/06/2018 TIME: 1200
WELL INSTALLATION FINISHED:
DATE: 06/06/2018 TIME: 1300
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~28'

WELL SCREEN

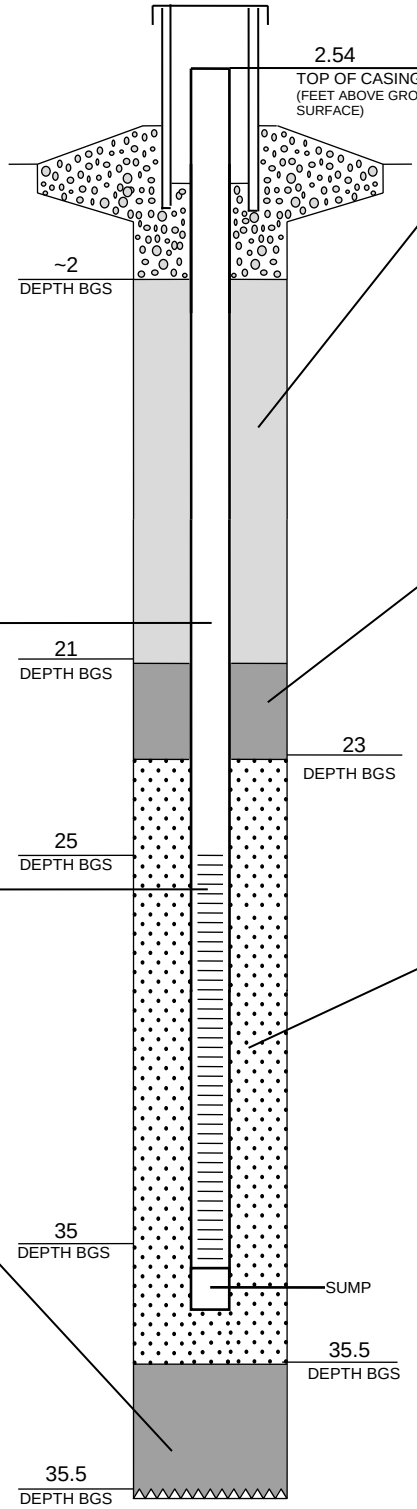
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 198.98
GROUND SURFACE ELEVATION: 196.4
NORTHING: 6959694.985
EASTING: 3310292.3
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: -
BENTONITE: -
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: -
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: -
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 26.59'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916097

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW25R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 42.73'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 06/01/2018 TIME: 0930
WELL INSTALLATION BEGAN:
DATE: 06/01/2018 TIME: 1200
WELL INSTALLATION FINISHED:
DATE: 06/01/2018 TIME: 1300
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~32'

WELL SCREEN

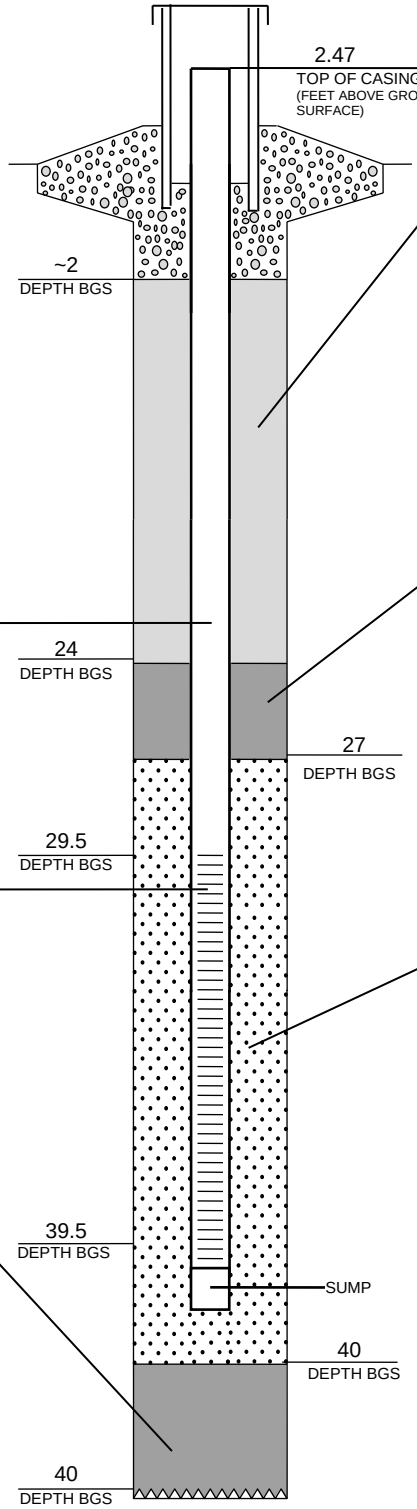
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 207.04
GROUND SURFACE ELEVATION: 204.6
NORTHING: 6959088.082
EASTING: 3307846.571
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: -
BENTONITE: -
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 15 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 10 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 31.28'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916098

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW26R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 42.05'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 06/11/2018 TIME: 1200
WELL INSTALLATION BEGAN:
DATE: 06/13/2018 TIME: 0830
WELL INSTALLATION FINISHED:
DATE: 06/13/2018 TIME: 1230
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~32'

WELL SCREEN

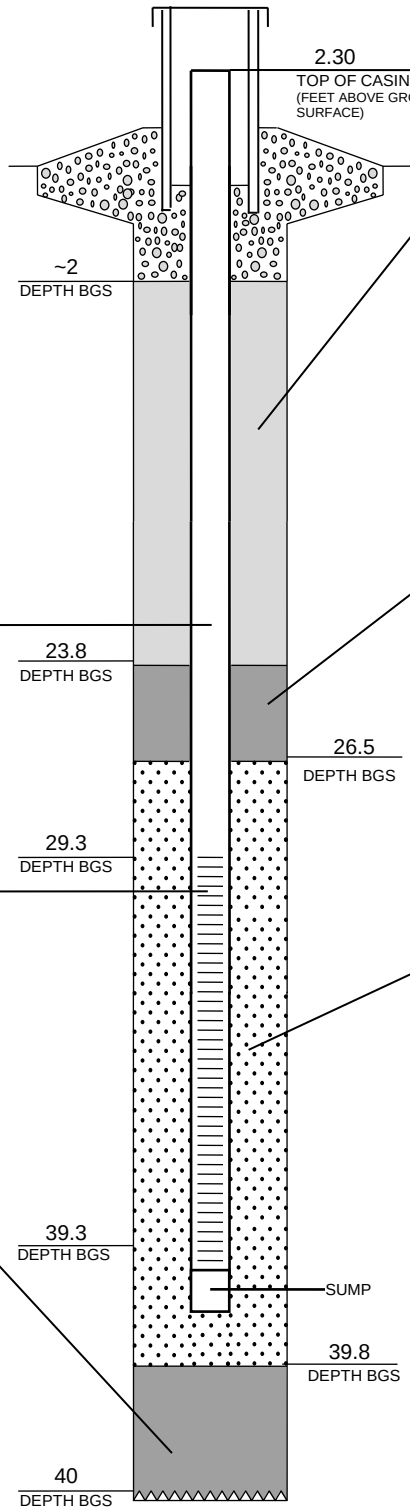
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 202.12
GROUND SURFACE ELEVATION: 199.8
NORTHING: 6958560.122
EASTING: 3309490.491
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: -
BENTONITE: -
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 10 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 12 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 31.35'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916099

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW39
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: NewWell1
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 42.13'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 05/29/2018 TIME: 0800
WELL INSTALLATION BEGAN:
DATE: 05/30/2018 TIME: 1000
WELL INSTALLATION FINISHED:
DATE: 05/30/2018 TIME: 1200
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~32'

WELL SCREEN

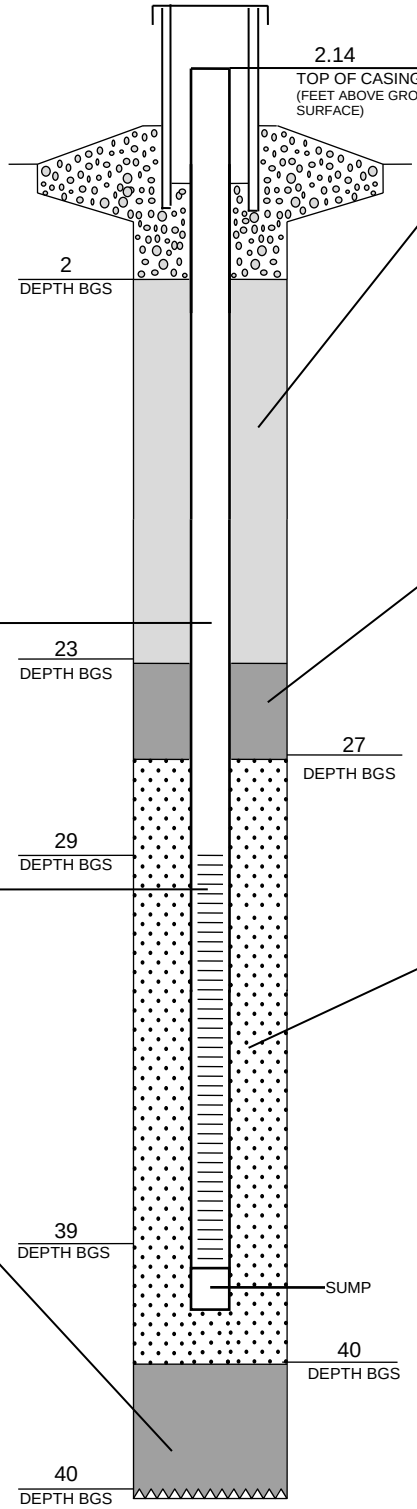
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 194.91
GROUND SURFACE ELEVATION: 192.8
NORTHING: 6960322.197
EASTING: 3310517.812
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 3 5-gallon buckets
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 9 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 24.07'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916100

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW40
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: SB-03
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 42.39'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 08/01/2018 TIME: 1520
WELL INSTALLATION BEGAN:
DATE: 08/02/2018 TIME: 0920
WELL INSTALLATION FINISHED:
DATE: 08/02/2018 TIME: 1500
DRILLING CO.: ETTL
DRILLER: Juwaun Martin/Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~32'

WELL SCREEN

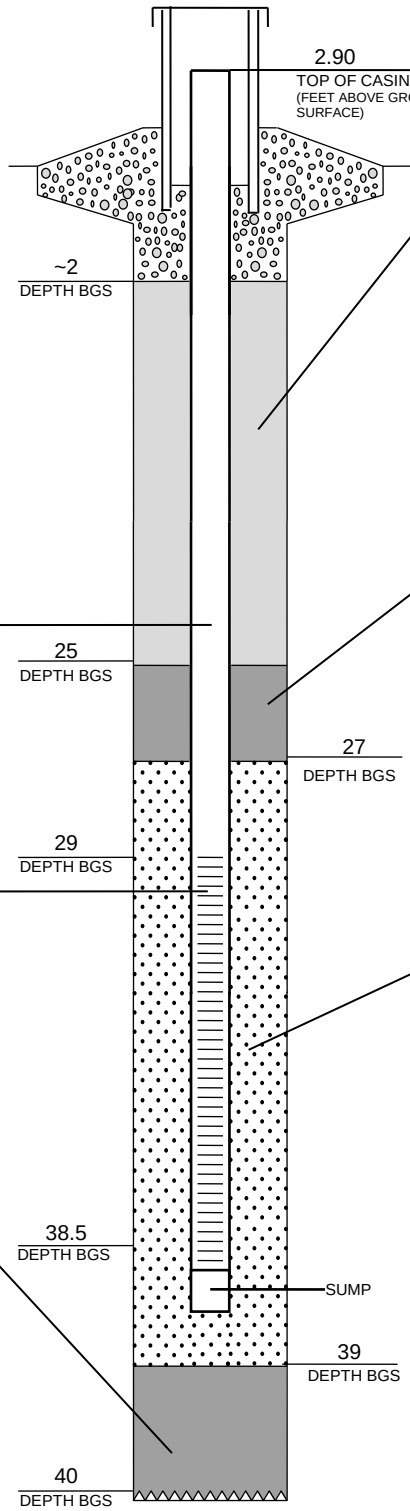
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
☒ FORMATION COLLAPSE: 1'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 198.24
GROUND SURFACE ELEVATION: 195.3
NORTHING: 6958303.453
EASTING: 3310011.946
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: 30 gallons
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 4 93-lb. bags
BENTONITE: ½ bag
WATER: 30 gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 2 5-gallon buckets
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: 10 gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 7 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 23.71'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916101

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW41
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: SB-04
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 40.03'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 08/01/2018 TIME: 0830
WELL INSTALLATION BEGAN:
DATE: 08/01/2018 TIME: 1115
WELL INSTALLATION FINISHED:
DATE: 08/01/2018 TIME: 1330
DRILLING CO.: ETTL
DRILLER: Juwaun Martin/Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~29'

WELL SCREEN

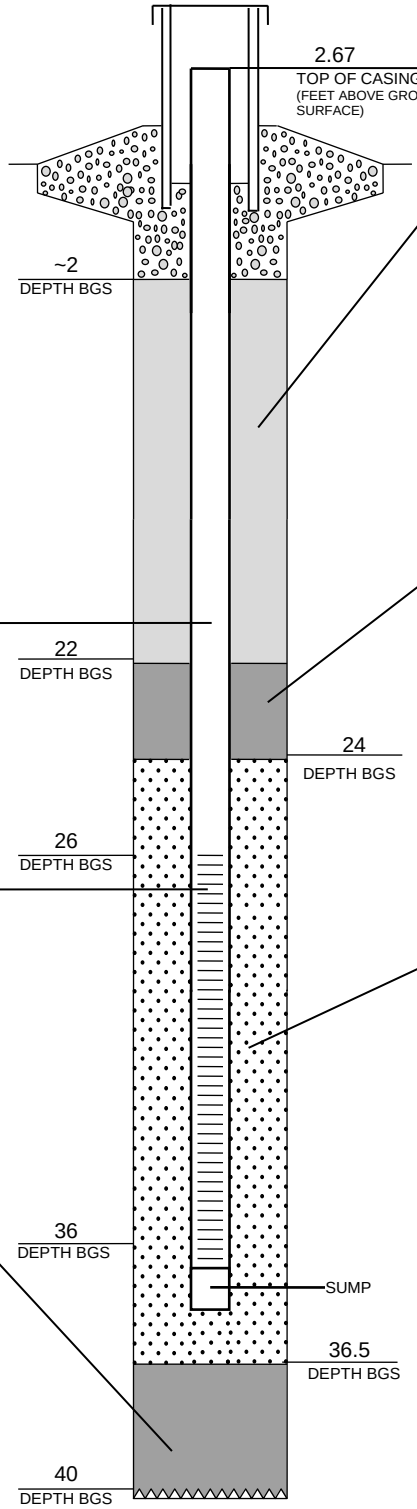
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
☒ FORMATION COLLAPSE: 3.5'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 201.48
GROUND SURFACE ELEVATION: 198.8
NORTHING: 6958774.291
EASTING: 3309828.457
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: 20 gallons
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: 20 gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 6 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: 10 gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 12 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: _____
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916102

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW42
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: SB-05
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 43.01'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 08/02/2018 TIME: 1535
WELL INSTALLATION BEGAN:
DATE: 08/03/2018 TIME: 1015
WELL INSTALLATION FINISHED:
DATE: 08/03/2018 TIME: 1200
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~33'

WELL SCREEN

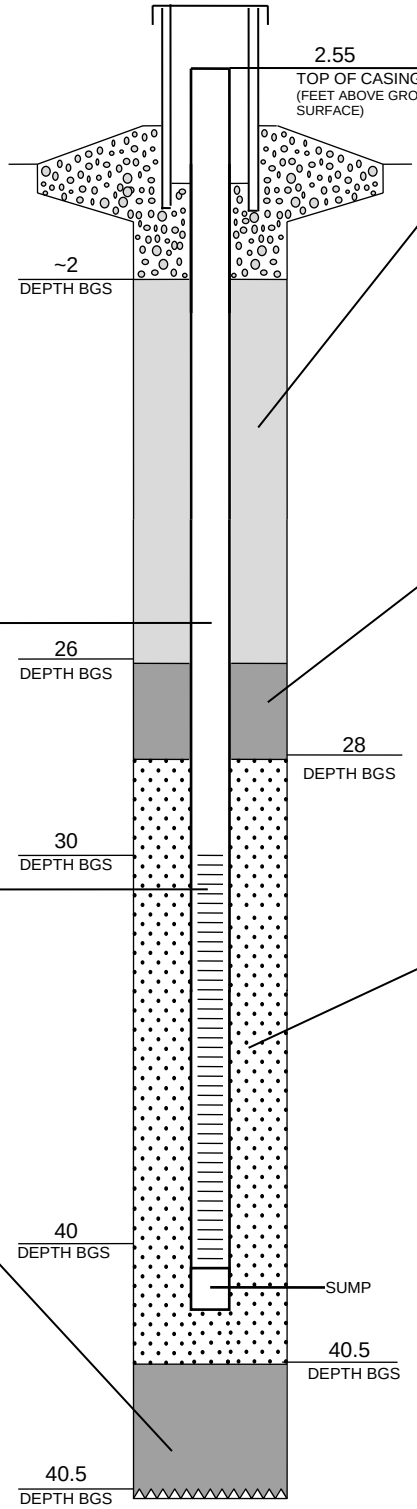
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 195.22
GROUND SURFACE ELEVATION: 192.7
NORTHING: 6958850.745
EASTING: 3310575.554
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: 20 gallons
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: 20 gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 7.5 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: 10 gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 9 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 22.13'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916103

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW43
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: SB-06
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 35.39'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 08/06/2018 TIME: 1015
WELL INSTALLATION BEGAN:
DATE: 08/06/2018 TIME: 1145
WELL INSTALLATION FINISHED:
DATE: 08/06/2018 TIME: 1600
DRILLING CO.: ETTL
DRILLER: Juwuan Martin/Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~25'

WELL SCREEN

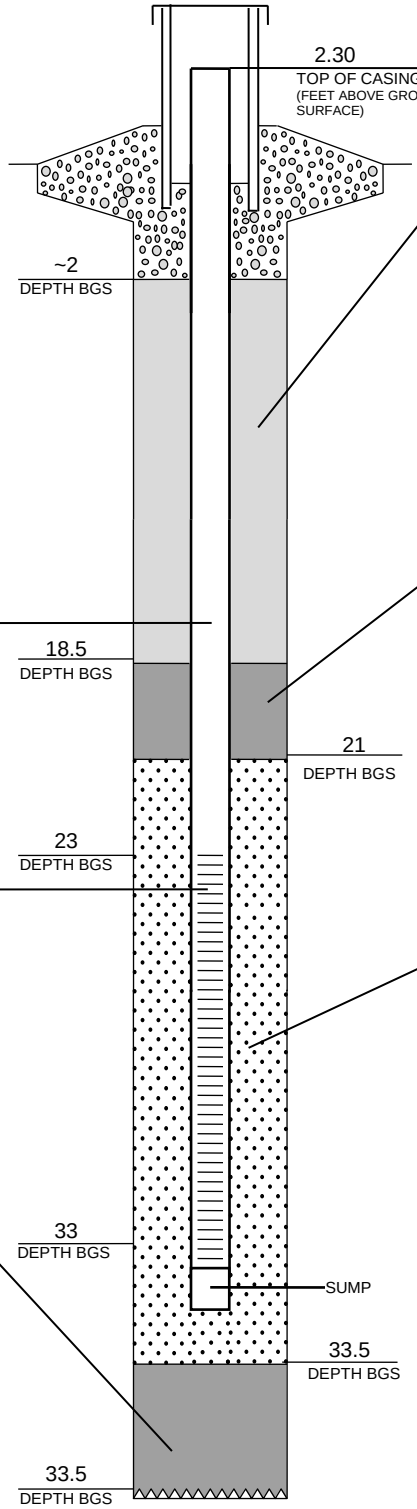
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 196.41
GROUND SURFACE ELEVATION: 194.1
NORTHING: 6959639.624
EASTING: 3309868.697
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: 40 gallons
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 4 93-lb. bags
BENTONITE: ½ bag
WATER: 40 gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 10 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: 10 gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 12 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 25.52'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916104

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW44
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: NewWell2
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 62.00'

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT

SURVEY INFORMATION

TOC ELEVATION: 195.04
GROUND SURFACE ELEVATION: 192.7
NORTHING: 6959793.183
EASTING: 3312722.693
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 08/22/2018 TIME: 1000
WELL INSTALLATION BEGAN:
DATE: 08/22/2018 TIME: 1500
WELL INSTALLATION FINISHED:
DATE: 08/22/2018 TIME: 1655
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
❑ HOLLOW STEM AUGER
❑ AIR ROTARY
☒ OTHER: wingbit/solid stem auger
DIAMETER OF AUGERS:
ID: - OD: 14"/8"

WELL CASING

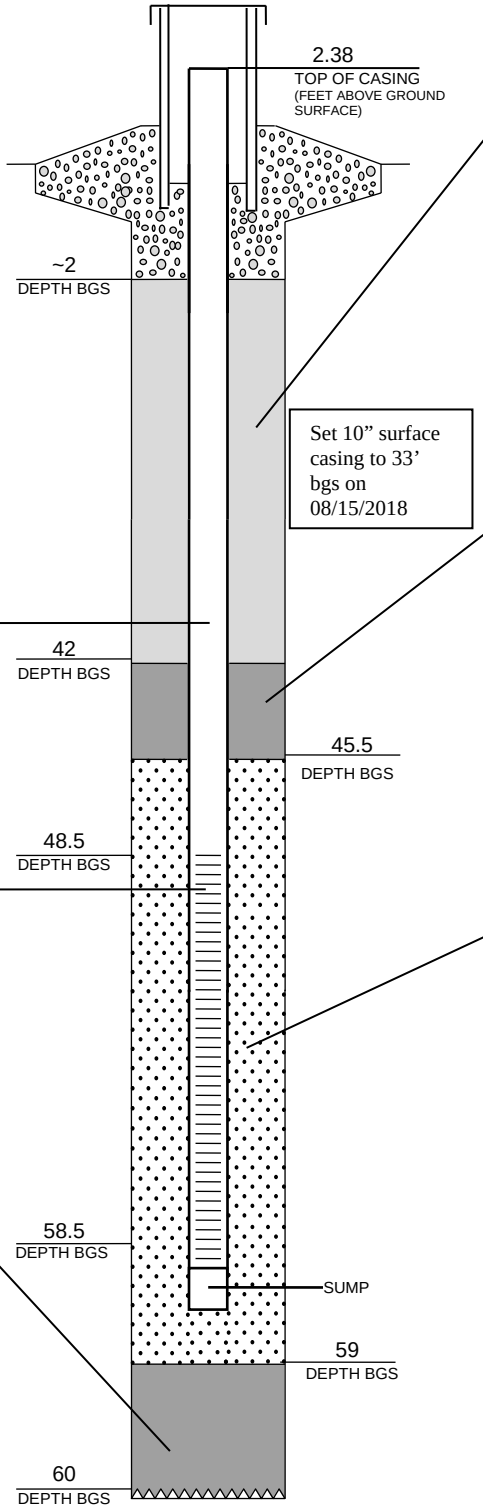
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~52'

WELL SCREEN

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
☒ FORMATION COLLAPSE: 1'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____



ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: 100 gallons
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: 100 gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 5 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 5 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ☒ TREMIE
❑ OTHER: _____
WATER LEVEL: 26.35'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916105

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW45
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: SB-07i
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 50.49'

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT

SURVEY INFORMATION

TOC ELEVATION: 188.05
GROUND SURFACE ELEVATION: 186.1
NORTHING: 6959769.404
EASTING: 3312018.475
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 08/16/2018 TIME: 0845
WELL INSTALLATION BEGAN:
DATE: 08/16/2018 TIME: 1030
WELL INSTALLATION FINISHED:
DATE: 08/17/2018 TIME: 0835
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
❑ HOLLOW STEM AUGER
❑ AIR ROTARY
☒ OTHER: wingbit/solid stem auger
DIAMETER OF AUGERS:
ID: - OD: 14"/8"

WELL CASING

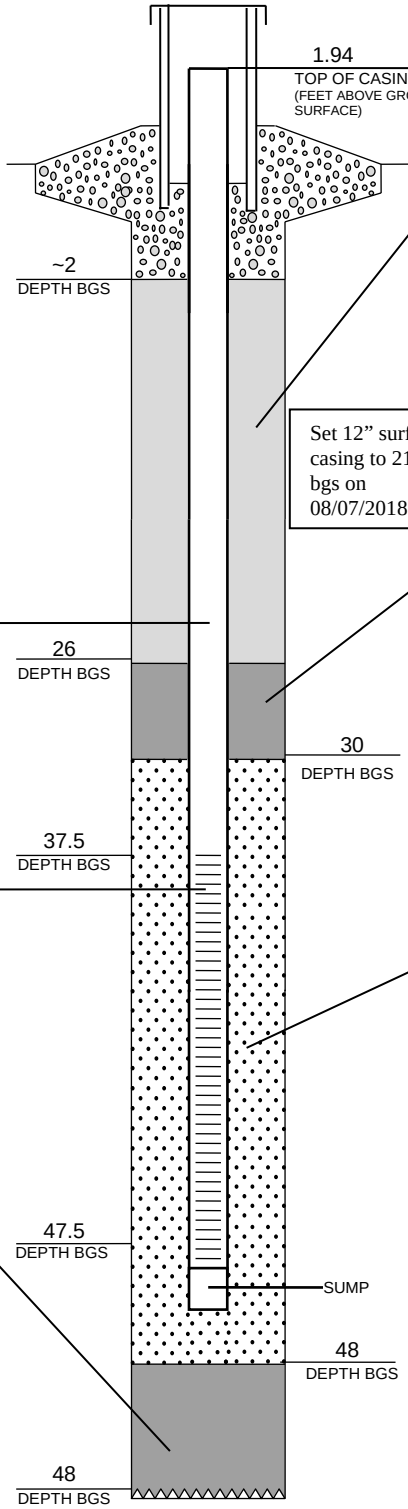
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~40'

WELL SCREEN

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
☒ FORMATION COLLAPSE: 18'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____



ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: 110 gallons
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: 110 gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 10 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: _____
❑ SAND, SIZE: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 19.36'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916106

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW46
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: SB-07i2
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 57.90'

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT

SURVEY INFORMATION

TOC ELEVATION: 191.05
GROUND SURFACE ELEVATION: 188.5
NORTHING: 6960386.394
EASTING: 3312581.587
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 08/23/2018 TIME: 1345
WELL INSTALLATION BEGAN:
DATE: 08/24/2018 TIME: 1010
WELL INSTALLATION FINISHED:
DATE: 08/24/2018 TIME: 1230
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
❑ HOLLOW STEM AUGER
❑ AIR ROTARY
☒ OTHER: wingbit/solid stem auger
DIAMETER OF AUGERS:
ID: - OD: 14"/8"

WELL CASING

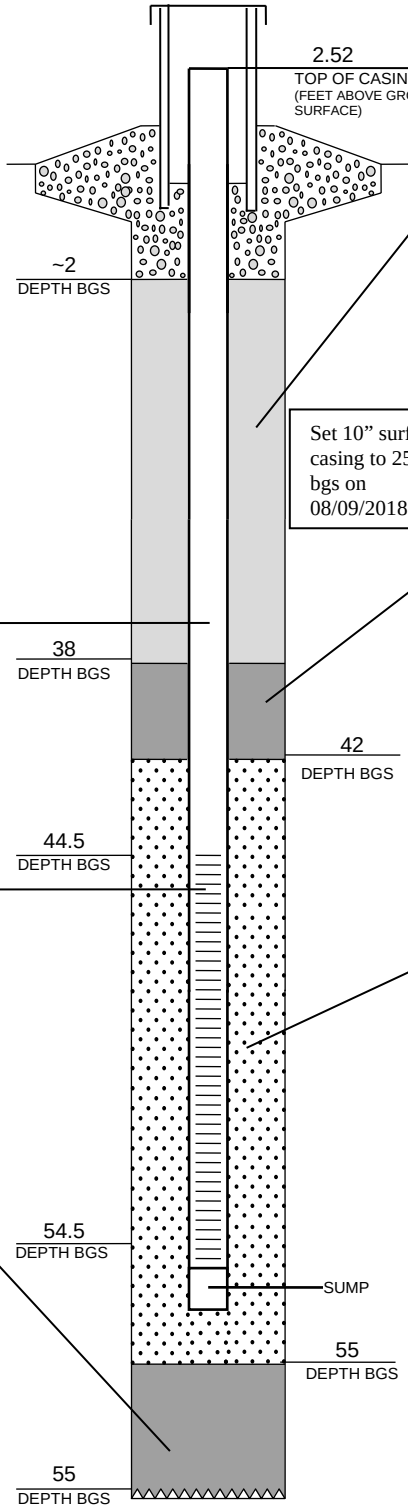
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~48'

WELL SCREEN

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____



ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: 110 gallons
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: 110 gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 5 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 5 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ☒ TREMIE
❑ OTHER: _____
WATER LEVEL: 21.22'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916107

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: 47WW47
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: SB-08i
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 55.45'

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT

SURVEY INFORMATION

TOC ELEVATION: 196.08
GROUND SURFACE ELEVATION: 193.6
NORTHING: 6958805.997
EASTING: 3312059.497
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 08/27/2018 TIME: 1420
WELL INSTALLATION BEGAN:
DATE: 08/28/2018 TIME: 1330
WELL INSTALLATION FINISHED:
DATE: 08/28/2018 TIME: 1530
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
❑ HOLLOW STEM AUGER
❑ AIR ROTARY
☒ OTHER: wingbit/solid stem auger
DIAMETER OF AUGERS:
ID: - OD: 14"/8"

WELL CASING

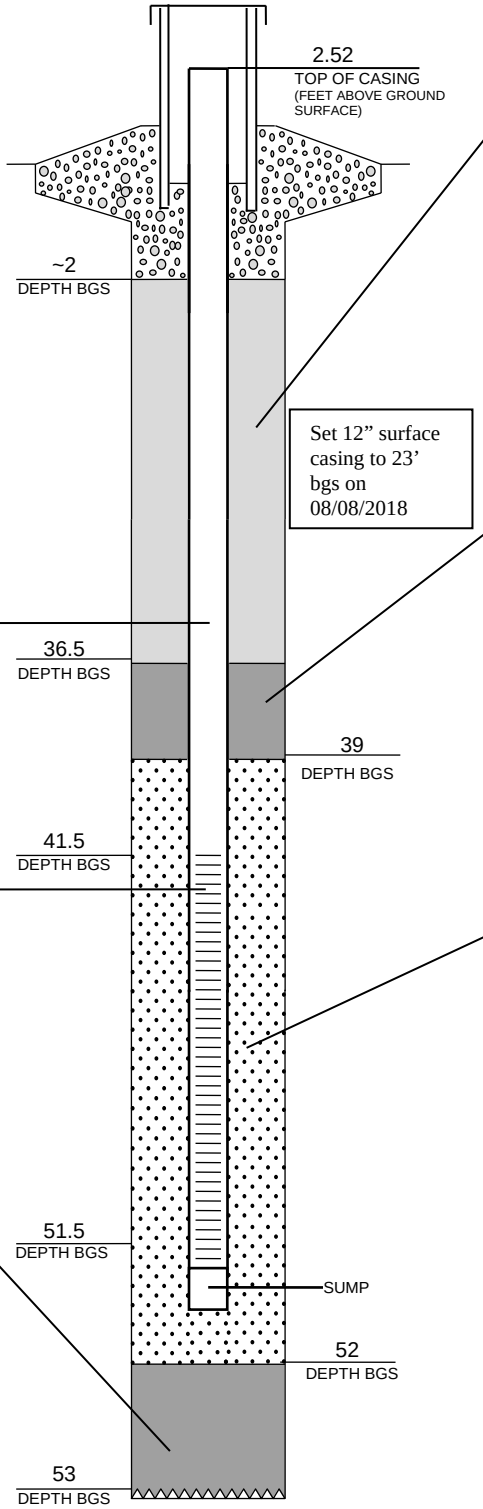
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~45'

WELL SCREEN

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
☒ FORMATION COLLAPSE: 1'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____



ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: 110 gallons
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: 110 gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 5 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 4 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ☒ TREMIE
❑ OTHER: _____
WATER LEVEL: 25.09'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916108

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: LHSMW42R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 41.95'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 06/14/2018 TIME: 1300
WELL INSTALLATION BEGAN:
DATE: 06/14/2018 TIME: 1650
WELL INSTALLATION FINISHED:
DATE: 06/14/2018 TIME: 1700
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: Diedrich D-50
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~31'

WELL SCREEN

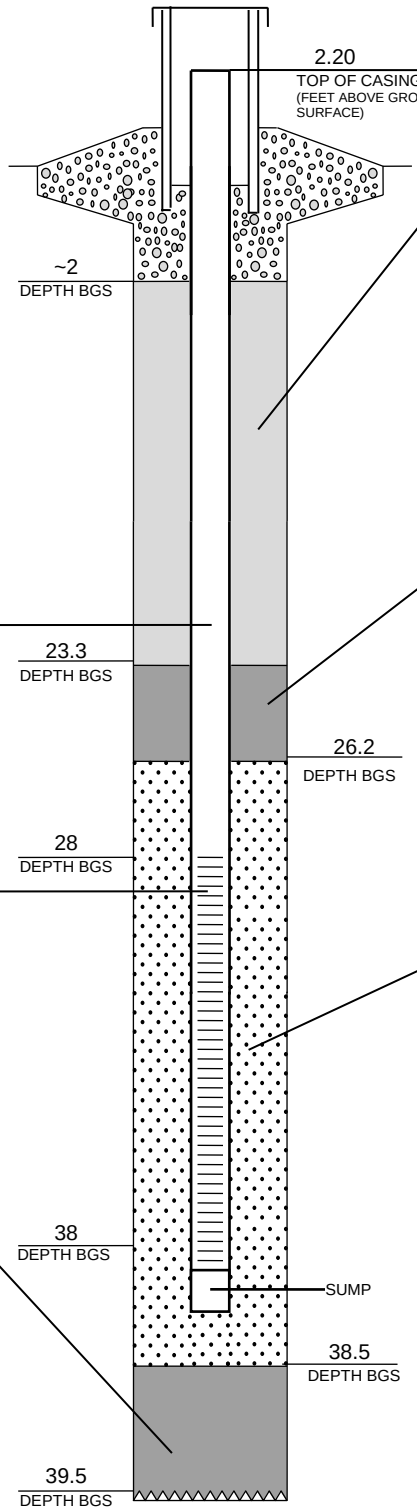
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
☒ FORMATION COLLAPSE: 1'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 200.61
GROUND SURFACE ELEVATION: 198.4
NORTHING: 6960519.58
EASTING: 3309540.589
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: -
BENTONITE: -
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: -
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 10 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 28.24'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916109

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: LHSMW43R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 36.91'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 05/30/2018 TIME: 1500
WELL INSTALLATION BEGAN:
DATE: 05/31/2018 TIME: 0900
WELL INSTALLATION FINISHED:
DATE: 05/31/2018 TIME: 1000
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~27'

WELL SCREEN

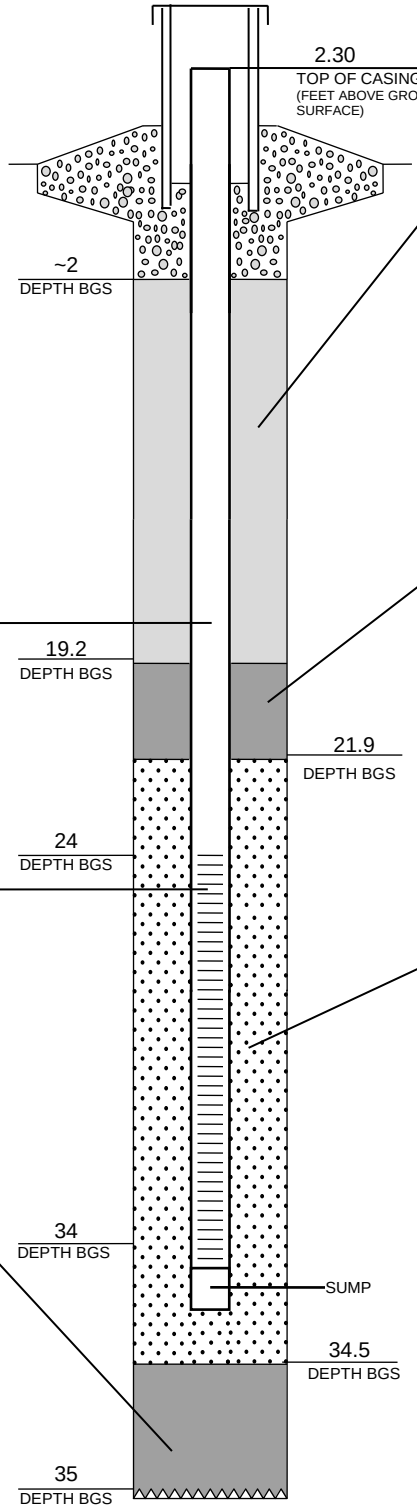
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
☒ FORMATION COLLAPSE: 0.5'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 199.31
GROUND SURFACE ELEVATION: 197.0
NORTHING: 6960015.708
EASTING: 3309643.464
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: -
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: -
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 26.51'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916110

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: LHSMW46R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 41.30'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 05/31/2018 TIME: 1200
WELL INSTALLATION BEGAN:
DATE: 05/31/2018 TIME: 1400
WELL INSTALLATION FINISHED:
DATE: 05/31/2018 TIME: 1600
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~27'

WELL SCREEN

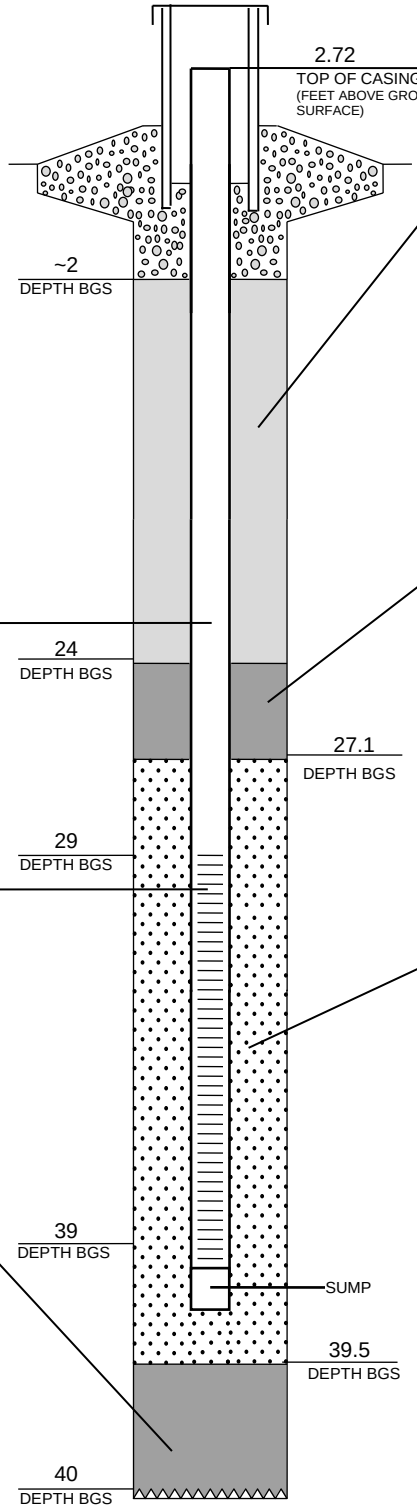
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
☒ FORMATION COLLAPSE: 0.5'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 201.37
GROUND SURFACE ELEVATION: 198.6
NORTHING: 6959758.72
EASTING: 3309375.428
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: -
BENTONITE: -
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: -
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: -
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 27.76'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916111

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: LHSMW55R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 38.17'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 06/07/2018 TIME: 1200
WELL INSTALLATION BEGAN:
DATE: 06/07/2018 TIME: 1530
WELL INSTALLATION FINISHED:
DATE: 06/07/2018 TIME: 1630
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~28'

WELL SCREEN

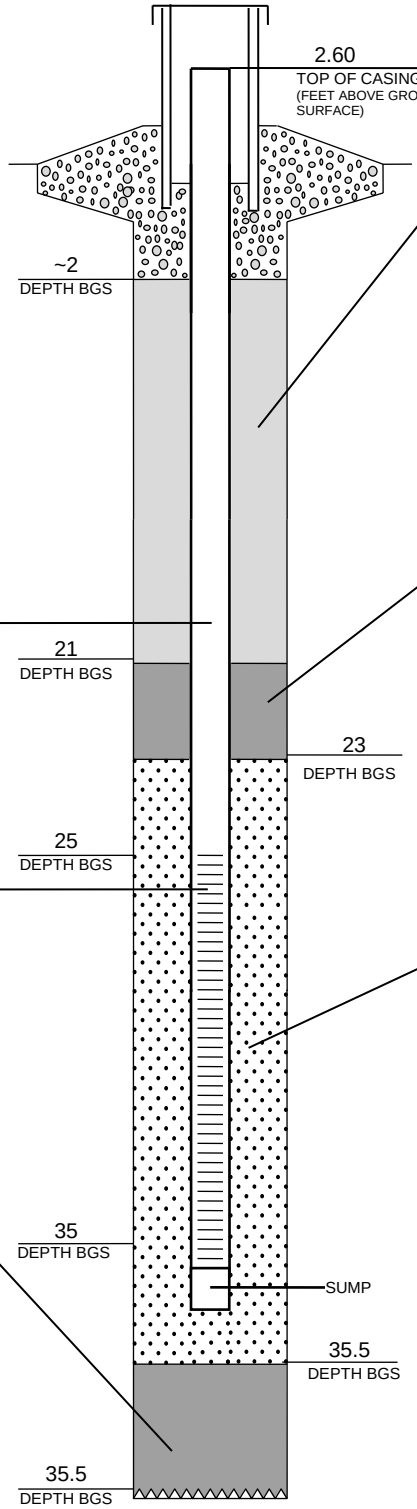
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 198.76
GROUND SURFACE ELEVATION: 196.2
NORTHING: 6959029.227
EASTING: 3310180.193
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: 3 93-lb. bags
BENTONITE: ½ bag
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 10 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 10 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 25.33'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

00916112

MONITORING WELL COMPLETION RECORD

MONITORING WELL

MONITORING WELL NO.: LHSMW56R
PROJECT: LHAAP-47 PSI
SITE: LHAAP-47
BOREHOLE NO.: -
WELL PERMIT NO.: NA
TOC TO BOTTOM OF WELL: 37.48'

DRILLING INFORMATION

DRILLING BEGAN:
DATE: 06/06/2018 TIME: 1400
WELL INSTALLATION BEGAN:
DATE: 06/07/2018 TIME: 0700
WELL INSTALLATION FINISHED:
DATE: 06/07/2018 TIME: 1015
DRILLING CO.: ETTL
DRILLER: Rich Herman
LICENSE: 59385M
DRILL RIG: CME 55
DRILLING METHOD:
☒ HOLLOW STEM AUGER
❑ AIR ROTARY
❑ OTHER: _____
DIAMETER OF AUGERS:
ID: 6.25" OD: 10.25"

WELL CASING

☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
LENGTH OF CASING: ~23'

WELL SCREEN

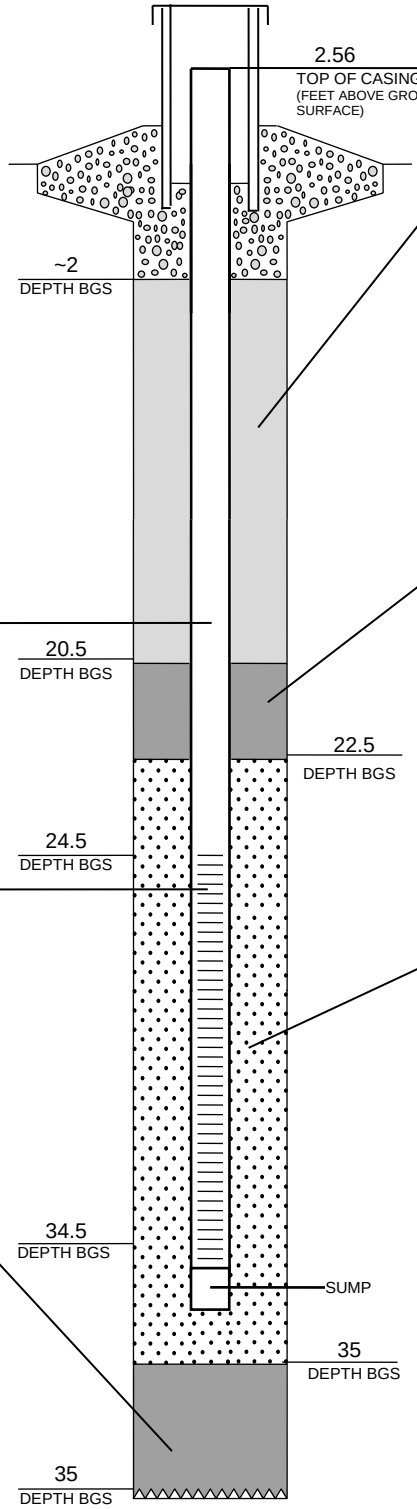
☒ SCHEDULE 40 PVC
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: 4" OD: 4.5"
SLOT SIZE: 0.010"
LENGTH OF SCREEN: 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED: NA
AMOUNT USED: NA
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____'
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
☒ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: 198.05
GROUND SURFACE ELEVATION: 195.5
NORTHING: 6959023.735
EASTING: 3310560.580
DATE SURVEYED: 09/24/2018
SURVEY CO.: Ark-La-Tex

ANNULAR SEAL

VOLUME CALCULATED: NA
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: -
BENTONITE: -
WATER: - gallons
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ☒ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: 10 gallons
☒ PELLETS, SIZE: 3/8"
❑ CHIPS, SIZE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: Pel-Plug
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
AMOUNT OF WATER USED: - gallons

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: 12 50-lb. bags
☒ SAND, SIZE: 20/40 sieve
PRODUCT: _____
MFG. BY: Pioneer Sands
METHOD INSTALLED:
☒ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: 25.17'
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ☒ NO;
CENTRALIZER DEPTHS: _____ _____

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

C

Well Development Forms

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW06	Date: 07/15/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M 4076, TURB. #6120		Water Level Indicator Type/ID #: GEOTECH #5886
	Equipment Group:		Equpment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX / BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: ~~27.70~~ 27.70
	Total Well Depth (ft) [d]: 47.90	Water Column Thickness (ft) [d-c]: 20.2'	Well Volume (gal) {[d-c] x b}: 23.56 CHANGE TO 15.73 GAL
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/15/18	1325	Pump	~~27.70~~	1.45	0.29	21.4	6.73	1600	1.63	51.4		131.4	INT
07/15/18	1330	Pump	31.00	↓	↓	20.2	6.57	1594	0.42	>1100		117.8	MOVE PUMP TO BOTTOM FOR SED. REMOVAL
07/15/18	1335	Pump	32.15			20.3	6.59	1594	0.44	326		101.1	
07/15/18	1340	Pump	32.60			20.7	6.60	1598	0.40	387		87.9	
07/15/18	1345	Pump	32.70			21.2	6.62	1599	0.38	136		79.9	
07/15/18	1350	Pump	32.70			21.3	6.60	1592	0.33	103		62.5	MOVE PUMP TO BOTTOM
07/15/18	1355	Pump	34.85	↓	↓	20.2	6.63	1594	0.29	76.4		54.5	STOP PUMP TO BAIL ABOUT 10 GALLONS
07/15/18	1400	Bail											
07/15/18	1405	Bail											
07/15/18	1410	Pump	32.55	1.45	0.29	22.3	6.86	1600	0.73	258		63.0	RESUME PUMPING
07/15/18	1415	Pump	33.80	↓	↓	20.4	6.78	1596	0.53	253		61.5	
07/15/18	1420	Pump	34.65	↓	↓	20.5	6.64	1595	0.43	228		57.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW06
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/15/18	1425	Pump	35.20	0.45	0.29	20.4	6.62	1595	0.35	173		48.0	
07/15/18	1430	Pump	35.55	1.45	0.29	20.6	6.61	1593	0.31	138		41.1	
07/15/18	1435	Pump	35.80	1.45	0.29	20.5	6.61	1594	0.29	102		32.8	
07/15/18	1445	Pump	35.20	2.9	0.29	20.6	6.62	1598	0.26	70.6		23.7	
07/15/18	1455	Pump	36.45	↓	↓	20.4	6.63	1605	0.26	51.8		18.0	
07/15/18	1505	Pump	37.00			20.2	6.64	1604	0.19	38.4		14.5	
07/15/18	1515	Pump	37.00			20.6	6.64	1606	0.17	23.8		11.6	
07/15/18	1525	Pump	37.30	↓	↓	20.3	6.63	1615	0.15	18.9		9.5	*STOP PUMP START BAILING 36 GALLONS
07/15/18	1530	Bail											
07/15/18	1535	Bail											STOP BAIL, RESUME PUMPING
07/15/18	1540	Pump	35.70	2.9	0.29	21.3	6.87	1627	0.49	214		26.5	
07/15/18	1550	Pump	36.20	↓	↓	21.4	6.67	1620	0.24	111		23.5	
07/15/18	1600	Pump	36.20			20.8	6.65	1620	0.19	73.5		16.6	
07/16/18	1820	Pump	27.80			19.4	7.03	1587	0.36	369		-1.9	PUMP SED. OFF BOTTOM
~~07/16/18~~	~~1825~~												JM
07/16/18	0830	Pump	32.60			19.8	6.87	1579	0.22	70.0		-20.3	NEW WELL VOLUME CALC. W/ 6"
07/16/18	0835	Bail											BOREHOLE = 15.736 AL
07/16/18	0840	Bail											STOP PUMP TO BAIL, 52 GALLONS PUMPED
07/16/18	0845	Bail											STOP BAIL RESUME PUMPING
07/16/18	0850	Pump	31.60	↓	↓	20.5	7.15	1577	0.43	72.3		-14.2	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW06
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/16/18	0900	Pump	32.70	1.3	0.26	20.1	6.81	1573	0.25	60.2		-25.4	
07/16/18	0910	Pump	30.85			22.8	8.00	8.7	6.94	—		23.5	PUMP NOT RUNNING, DISREGARD READINGS
07/16/18	0920	Pump	32.80			20.0	6.79	1583	0.24	40.0		-19.6	
07/16/18	0930	Pump	33.95			20.2	6.80	1584	0.22	32.3		-22.7	
07/16/18	0940	Pump	33.40			21.2	6.78	1571	0.18	18.8		-29.0	
07/16/18	0950	Pump	34.70			20.2	6.78	1586	0.20	23.4		-25.1	
07/16/18	1000	Pump	34.75			20.2	6.78	1576	0.16	20.7		-30.3	
07/16/18	1010	Pump	34.60			20.3	6.77	1578	0.15	12.5		-34.2	
07/16/18	1020	Pump	34.70			20.2	6.81	1592	0.14	14.5		-35.2	
07/16/18	1030	Pump	34.56			20.3	6.77	1583	0.12	12.8		-38.3	
07/16/18	1040	Pump	32.20			20.7	6.76	1582	0.10	9.42		-38.8	
07/16/18	1045	Pump	34.45			20.0	6.76	1589	0.10	8.26		-37.4	
07/16/18	1050	Pump	34.60	↓	↓	20.2	6.76	1591	0.10	9.50		-38.6	1½ DRUMS, 83 GALLONS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW08R	Date: 07/04/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: YSI/GEOTECH TURB. METER		Water Level Indicator Type/ID #: GEOTECH #6162
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP		Equipment Decon.: ALCONOX/BUCKET
WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) ([d-c] x b):
	Ground Condition of Well:	Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/04/18	0905	Pump	28.00			20.5	7.16	3905	0.45	>1100		130.1	TOP OF SCREEN = 31.6
07/04/18	0910	Pump	28.85			20.2	6.93	3846	0.23	>1100		125.0	DROP PUMP DOWN TO BOTTOM
07/04/18	0915	Pump	30.30			19.8	6.89	3818	0.34	>1100		122.3	SURGE/BACKWASH W/ PUMP
07/04/18	0920	Pump	31.25			19.7	6.85	3848	0.52	>1100		118.8	
07/04/18	0925	Pump	31.70			19.7	6.84	3945	0.49	528		116.1	
07/04/18	0930	Pump	30.85			19.7	6.81	4019	0.41	>1100		114.0	SURGE/BACKWASH W/PUMP
07/04/18	0935	Pump	32.80			19.5	6.84	4171	0.45	>1100		113.4	
07/04/18	0940	~~Bail~~											BAIL SEDIMENT
07/04/18	0945	Bail	28.50										BAIL SEDIMENT
07/04/18	0950	Pump	28.50			20.3	7.04	4161	1.19	>1100		112.6	
07/04/18	0955	Pump	31.25			19.7	6.86	4254	0.54	>1100		114.2	
07/04/18	1000	Pump	31.40	5.0	1.0	19.7	6.85	4302	0.50			113.8	2/3 DRUM

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW08R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) ORP	Remarks (odor, clarity, etc.)
07/04/18	1005	Pump	31.10	5.0	1.0	19.7	6.78	4169	0.37	>1100		112.5	SURGE W/ PUMP
07/04/18	1010	Pump	31.30	5.0	1.0	19.7	6.84	4406	0.30	>1100		112.7	
07/04/18	1015	BAIL				~~20.8~~	~~6.93~~	~~4326~~	~~0.82~~				BAIL SEDIMENT
07/04/18	1020	BAIL	29.65			20.8	6.93	4326	0.82	>1100		110.2	BAIL SEDIMENT
07/04/18	1025	Pump	29.79	5.0	1.0	19.9	6.82	4295	0.52	>1100		112.7	
07/04/18	1030	Pump	30.01	5.0	1.0	20.0	6.87	4541	0.97	>1100		113.0	
07/04/18	1035	Pump	30.05	5.0	1.0	19.8	6.79	4275	0.28	818		111.1	
07/04/18	1040	Pump	30.15	5.0	1.0	19.9	6.87	4497	0.50	847		111.3	
07/04/18	1045	Pump	30.38	5.0	1.0	19.7	6.84	4428	0.32	513		109.6	ODOR
07/04/18	1050	Pump	30.41	5.0	1.0	19.8	6.82	4401	0.25	321		108.7	
07/04/18	1055	Pump	30.42	5.0	1.0	19.8	6.86	4553	0.29	226		108.6	
07/04/18	1100	BAIL											BAIL SEDIMENT
07/04/18	1105	BAIL	28.75			20.2	6.93	4426	0.58	945		108.0	BAIL SEDIMENT
07/04/18	1110	Pump	31.01	5.0	1.0	19.7	6.80	4374	0.31	800		109.9	
07/04/18	1115	Pump	31.01	5.0	1.0	19.7	6.80	4429	0.35	483		109.1	
07/04/18	1120	Pump	31.01	5.0	1.0	19.7	6.81	4384	0.21	642		107.8	
07/04/18	1125	Pump	31.10	5.0	1.0	19.7	6.81	4446	0.19	573		107.1	
07/04/18	1130	Pump	31.11	5.0	1.0	19.7	6.82	4494	0.16	104		106.4	
07/04/18	1135	Pump	31.10	5.0	1.0	19.8	6.80	4521	0.14	52.5		105.9	
07/04/18	1140	Pump	31.10	5.0	1.0	19.7	6.81	4535	0.13	35.3		105.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW08R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/04/18	1145	Pump	31.10	5.0	1.0	19.7	6.79	4507	0.13	64.3		105.7	
07/04/18	1150	Pump	31.10	5.0	1.0	19.8	6.78	4378	0.11	96.1		103.2	
07/04/18	1155	Pump	31.03	5.0	1.0	19.7	6.80	4524	0.10	40.6		102.3	Surge w/ Pump
07/04/18	1200	Pump	30.99	5.0	1.0	19.7	6.74	4336	0.09	73.3		100.3	
07/04/18	1205	Pump	31.02	5.0	1.0	19.7	6.81	4509	0.10	35.3		101.5	Surge w/ Pump
07/04/18	1210	Pump	31.05	5.0	1.0	19.7	6.84	4628	0.11	55.5		100.9	
07/04/18	1215	Pump	31.10	5.0	1.0	19.7	6.80	4624	0.10	16.1		100.4	
07/04/18	1220	Pump	31.10	5.0	1.0	19.7	6.80	4596	0.10	12.6		100.0	Surge w/ Pump
07/04/18	1225	Pump	31.10	5.0	1.0	19.7	6.79	4432	0.07	25.8		98.3	
07/04/18	1230	Pump	31.10	5.0	1.0	19.6	6.80	4531	0.07	11.6		98.3	
07/04/18	1235	Pump	31.10	5.0	1.0	19.7	6.80	4629	0.07	5.42		97.8	
07/04/18	1240	Pump	31.10	5.0	1.0	19.7	6.80	4606	0.07	2.27		97.0	
07/04/18	1245	Pump	31.10	5.0	1.0	19.7	6.79	4551	0.06	0.31		97.0	
													2.5 drums = 137.5 gallons

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47		LocID: 47WW09			Date: 07/16/18					
	Project Name: Longhorn Army Ammunition Plant		Project #: 100977916			Recorded By: JM Checked By: WTR					
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ 4M4076, TURB. METER #6120					Water Level Indicator Type/ID #: GEOTECH #5886					
	Equipment Group:					Equipment Group:					
	Development Equipment: TORNADO PUMP & BAILER					Equipment Decon.: ALCONOX & BUCKET					
WELL INFO	Casing I.D. (in) [a]: ~~6"~~ JM		Unit Casing Volume (gal/lin ft) [b]:			Initial Depth to Water (ft) [c]: 27.55' BTOC					
	Total Well Depth (ft) [d]: 41.30' BTOC		Water Column Thickness (ft) [d-c]: 13.75' ~~BTOC~~ JM			Well Volume (gal) {[d-c] x b}: 15.4					
	Ground Condition of Well:					Remarks: SLOW RECHARGE					
CASING INFO	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/16/18	1150	Pump	28.65			21.4	8.08	2888	1.24	23.2		779	INT. -BLACK COLOR
07/16/18	1155	Pump	31.95			19.1	8.15	2832	0.22	>1100		-10.8	DROP PUMP TO BOTTOM
07/16/18	1200	Pump	~~32~~ 32.75			19.9	9.03	2693	0.31	17.6		-80.9	STRONG ODOR
07/16/18	1205	Pump	34.05			19.6	9.16	2656	0.35	78.3		-57.5	
07/16/18	1210	Pump	36.80			18.6	8.97	2617	0.32	28.2		-64.7	STOP PUMP FOR RECHARGE
~~07/16/18~~	~~1225~~	~~Pump~~				18.7							JM
07/17/18			32.55										~~PUMP~~ JM DID NOT RECHARGE
08/21/18	0820	Bail	27.64										BAIL FOR 10 MIN
08/21/18	0835	Pump	30.79			19.0	7.66	3069	5.43	19.6		-147.0	DROP PUMP TO SCREEN BOTTOM
08/21/18	0840	Pump	31.71			19.3	7.68	3056	3.23	37.4		-142.0	SURGE W/ PUMP
08/21/18	0845	Pump	32.60	0.75	0.15	19.2	7.67	3031	2.23	29.3		-159.6	
08/21/18	0850	Pump	33.30	1.50	0.15	19.4	7.67	3036	1.64	23.7		-152.0	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW097~~916~~ JM
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/21/2018	0855	Pump	33.51	2.00	0.10	19.9	7.68	3044	1.53	23.3		-145.0	SLOW PUMP RATE
08/21/2018	0900	Pump	33.59	2.50	0.10	20.5	7.68	3045	1.48	21.6		-141.4	
08/21/2018	0905	Pump	33.79	3.00	0.10	20.1	7.68	3042	1.39	23.5		-139.0	
08/21/2018	0910	Pump	34.10	5.50	0.10	20.1	7.68	3035	1.31	22.6		-137.8	
08/21/2018	0915	Pump	34.30	4.00	0.10	20.5	7.68	3033	1.23	20.4		-134.9	
08/21/2018	0920	Pump	34.50	4.50	0.10	20.3	7.68	3030	1.13	25.1		-132.9	
08/21/2018	0925	Pump	34.70	5.00	0.10	20.1	7.68	3025	1.03	20.6		-131.8	
08/21/2018	0930	Pump	35.00	5.50	0.10	20.3	7.69	3020	0.96	22.5		-128.5	
08/21/2018	0935	Pump	35.20	6.00	0.10	20.0	7.69	3025	0.84	16.7		-125.6	
08/21/2018	0940	Pump	35.80	6.50	0.10	19.8	7.66	3022	0.74	12.4		-125.4	
08/21/2018	0945	Pump	36.00	7.00	0.10	20.1	7.66	3024	0.74	14.0		-124.4	
08/21/2018	0950	Pump	36.40	7.50	0.10	20.4	7.65	3031	0.70	10.7		-123.8	
08/21/2018	0955	Pump	36.60	8.00	0.10	20.1	7.63	3036	0.65	16.3		-121.8	STOP PUMP TO BAIL FOR 10 MIN
08/21/2018	1000	BAIL											
08/21/2018	1005	BAIL											STOP BAIL, RESUME PUMPING
08/21/2018	1010	Pump	37.90	8.50	0.10	20.7	7.67	3046	5.14	48.3		-69.6	
08/21/2018	1015	Pump	37.90	9.00	0.10	21.3	7.65	3047	4.80	47.0		-71.0	
08/21/2018	1020	Pump	38.10	9.50	0.10	21.2	7.64	3046	4.74	36.1		-71.1	
08/21/2018	1025	Pump	38.40	10.00	0.10	21.7	7.62	3051	1.63	29.2		-64.3	
08/21/2018	1030	Pump	38.71	10.50	0.10	20.5	7.62	3047	2.80	33.7		-67.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW09
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979 16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/21/2018	1035	Pump	28.90	11.00	0.10	20.2	7.61	3045	2.21	26.9		-70.4	
08/21/2018	1040	Pump	29.30	11.50	0.10	20.2	7.60	3040	2.03			-66.5	DEWATERED, WILL RETURN
09/06/2018	1735	Pump	29.16			19.3	7.44	3222	0.25	14.5		-117.3	
09/06/18	1740	Pump	29.31			19.8	7.36	3240	0.25	7.94		-117.5	
09/06/18	1745	Pump	30.22			20.4	7.35	3219	0.22	4.14		-119.4	
09/06/18	1750	Pump	31.00			20.2	7.34	3232	0.19	3.84		-120.5	
09/06/18	1755	Pump	31.16			22.0	7.33	3239	0.19	5.68		-121.1	
09/06/18	1800	Pump	31.53			20.2	7.33	3238	0.16	3.85		-120.8	
09/06/18	1805	Pump	32.19			20.1	7.34	3220	0.13	3.97		-115.4	
09/06/18	1810	Pump	33.92			19.5	7.37	3206	0.11	4.62		-109.8	
09/06/18	1815	Pump	34.20			19.7	7.39	3191	0.10	3.89		-109.9	
09/06/18	1820	Pump	34.24			20.2	7.40	3188	0.10	2.13		-110.0	
09/06/18	1825	Pump				20.3	7.44	3174	0.16	2.08		-108.0	
09/06/18	1830	Pump				20.0	7.46	3167	0.24	2.36		-103.6	
09/06/18	1835	Pump				19.8	7.45	3161	0.28	1.64		-98.2	
09/06/18	1840	Pump				20.1	7.44	3159	0.28	2.78		-95.7	
09/06/18	1845	Pump	35.78	49.0		20.4	7.44	3159	0.30			-92.9	~50 GALLONS REMOVED

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

00916124
00191261

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: ~~LH547~~WW11R	Date: 07/02/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: YSI / Geotech turb meter	Water Level Indicator Type/ID #: Geotech #6162	
	Equipment Group:	Equipment Group:	
	Development Equipment: TORNADO PUMP	Equipment Decon.: Big Red Bucket	
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 26.00
	Total Well Depth (ft) [d]: 37.85 TOC	Water Column Thickness (ft) [d-c]: 9.85	Well Volume (gal) {[d-c] x b}: 15.4 gallons x 3 = 46.2
	Ground Condition of Well: Cleared	Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/02/18	1150	Pump	27.15	INT		20.6	6.54	5171	1.87	952		47.6	INT
07/02/18	1155	Pump	26.50	2.5	0.5	19.8	6.53	5178	0.48	>1100		24.9	Removing Sed. from Bottom
07/02/18	1200	Pump	26.50			19.8	6.65	5258	1.65	>1100		10.6	" "
07/02/18	1205	Pump	26.88			21.5	6.82	4750	0.21	240		17.0	
07/02/18	1210	Pump	26.90			20.1	6.84	4675	0.23	7100		15.7	
07/02/18	1215	Pump	26.95			19.5	6.84	63.6	0.24			12.2	
07/02/18	1220	Bail											Bailing Sediment
07/02/18	1225	Bail	26.30										Bailing Sediment
07/02/18	1230	Pump	27.30			19.8	6.66	5045	0.66	873		35.2	
07/02/18	1235	Pump	27.50			19.8	6.62	5018	0.41	>1100		27.8	
07/02/18	1240	Pump	27.59			19.7	6.64	4669	0.24	574		26.3	
07/02/18	1245	Pump	27.82			19.7	6.66	4673	0.15	212		23.6	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: ~~LHS~~47WW11R
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP	Remarks (odor, clarity, etc.)
07/02/2018	1250	BAIL											BAILING SEDIMENT
07/02/2018	1300	Pump	~~26.20~~	5.0	1.0	20.7	6.76	4979	0.59	>1100		43.2	
07/02/2018	1305	Pump	27.20			19.9	6.60	5139	0.46	>1100		38.1	
07/02/2018	1310	Pump	27.28			19.8	6.63	4781	0.20	1080		34.2	
07/02/2018	1315	Pump	27.33			19.8	6.63	5029	0.26	>1100		30.9	
07/02/2018	1320	Pump	27.34			19.7	6.61	5049	0.20	352		28.2	
07/02/2018	1325	Pump	27.41			19.7	6.65	5059	0.19	245		26.0	
~~07/02/2018~~	~~1330~~	~~BAIL~~	~~27.41~~			~~19.7~~	~~6.67~~						BAILING
07/02/2018	1340	Pump	26.30			20.9	6.80	4881	0.49	>1100		33.7	
07/02/2018	1345	Pump	28.00			19.7	6.61	5009	0.32	907		32.5	
07/02/18	1350	Pump	27.30			19.8	6.66	4647	0.19	753		31.6	
07/02/18	1355	Pump	27.85			19.6	6.64	5022	0.14	442		28.8	
07/02/18	1400	Pump	27.55			19.7	6.66	4802	0.15	324		28.2	
07/02/18	1405	Pump	27.57			19.7	6.66	4933	0.16	165		25.7	
07/02/18	1410	Pump	27.58			19.7	6.66	4840	0.11	9.38		25.0	
07/02/18	1415	Pump	27.55			19.7	6.67	4943	0.10	34.6		22.7	
07/02/18	1420	Pump	27.55			19.7	6.69	4232	0.06	118		21.7	
07/02/18	1425	Pump	27.55			19.6	6.69	4742	0.11	35.4		22.2	
07/02/18	1430	Pump	27.55			19.6	6.69	4874	0.11	21.1		21.7	
07/02/18	1435	Pump	27.65	↓	↓	19.5	6.69	4822	0.10	13.9		21.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: ~~LH~~47WW11R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~cRadiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/02/18	1440	Pump	27.60	5.0	1.0	19.6	6.65	5265	0.15	15.4		21.7	
07/02/18	1445	Pump	27.50	↓	↓	19.7	6.67	4970	0.13	8.96		20.0	
07/02/18	1450	Pump	27.55			19.6	6.69	4874	0.13	3.65		19.8	
07/02/18	1455	Pump	27.60	↓	↓	19.7	6.70	4784	0.13	2.60		20.1	2 2/3 DRUMS 146 Gallons

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47GW13	Date: 7/6/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116	Recorded By: CTK Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M4076, TURB #6120		Water Level Indicator Type/ID #: GEOTECH #5886
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKETS
WELL INFO	Casing I.D. (in) [a]: 4 in	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 9.90
	Total Well Depth (ft) [d]: ~~19.60~~ 19.60	Water Column Thickness (ft) [d-c]:	Well Volume (gal) ([d-c] x b): 1.75 gallons
	Ground Condition of Well: Overgrown	Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation cpm	Remarks (odor, clarity, etc.)
7/6/18	1345	Pump	12.5			21.7	5.25	1436	1.15	119.		133.0	Milky
	1415		18.6										Begin Sed Removal
	1421		18.7										Let Recharge
7/7/18			17.00	NOT ENOUGH WATER									Very slow Recharge
08/21/18	1155	BAIL	12.69										~3' OF SEDIMENT @ BOTTOM OF WELL
08/21/18	1200	↓											
08/21/18	1205												
08/21/18	1210												
08/21/18	1215	BAIL	19.10										STOP SURGING W/ BAIL, START PUMPING
08/21/18	1220	Pump	15.27			23.6	6.16	174.0	4.42	>1100		122.9	MILKY
18 GAL PUMPED → 08/21/18	1225	Pump	17.40			23.1	5.98	139.7	5.80	>1100		152.4	
08/21/18	1230	Pump	19.60										DEWATERED, STILL ALOT OF SEDIMENT @ BOTTOM

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

WELL HAS Dedicated tubing Explosives

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW14	Date: 07/06/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ 4M4075		Water Level Indicator Type/ID #: GEOTECH #6162
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP		Equipment Decon.: ALCONOX / BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 29.50
	Total Well Depth (ft) [d]: 51.70	Water Column Thickness (ft) [d-c]: 22.2	Well Volume (gal) ([d-c] x b): 21.94 GAL
	Ground Condition of Well:		Remarks: 21.94 GAL / 1 WELL VOLUME

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/06/18	1345	Pump	29.50			21.8	8.82	1608	2.17			68.5	INT.
07/06/18	1348												LIGHTNING SHUTDOWN
07/06/18	1410												RESET PUMP
07/06/18	1420	Pump	31.40			21.9	7.34	1950	1.01	>1100		-25.5	
07/06/18	1425	Pump	35.42			22.0	7.21	1762	0.18	>1100		-57.0	
07/06/18	1430	Pump	38.58			22.0	7.28	1486	0.32	61.0		-52.1	VARYING TURB.
07/06/18	1435	Pump	39.20			21.9	7.12	1746	0.17	>1100		-77.1	
	1445												LIGHTNING SHUTDOWN
07/07/18	0850	Pump	29.53			21.7	7.61	1589	3.28	69.2		63.9	INT
07/07/18	0855	Pump	34.25			21.8	7.19	1623	0.86	67.1		-23.3	STOP PUMP TO BAIL
07/07/18	0900	BAIL											
07/07/18	0905	BAIL											

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

EXPLOSIVES

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW14
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) DRO	Remarks (odor, clarity, etc.)
07/07/18	0910	BAIL	30.85	5.0	1.0	22.5	7.87	1660	1.67	>1100		-42.5	Pump on well Bottom
07/07/18	0915	Pump	37.00			21.8	7.14	1574	0.22	>1100		-51.5	
07/07/18	0920	Pump	35.45			22.1	7.10	1645	0.20	240		-40.9	
07/07/18	0925	Pump	34.05			22.0	7.22	1377	0.32	140		-26.1	
07/08/18	0930	Pump	34.60			21.9	7.10	1574	0.21	368		-36.3	SURGE W/ Pump
07/08/18	0935	Pump	34.70			21.9	7.11	1615	0.13	643		-21.3	
07/08/18	0940	Pump	34.15			21.9	7.09	1716	0.09			-22.8	STOP PUMP TO ~~SURGE~~ BAIL
07/08/18	0945	BAIL											
07/08/18	0950	Pump	30.95			22.0	7.35	1481	0.33	268		30.5	STOP BAILING, RESUME PUMPING
07/08/18	0955	Pump	32.85			21.9	7.23	1317	0.33	196		18.4	
07/08/18	1000	Pump	33.50			21.9	7.23	1297	0.33	157		16.1	
07/08/18	1005	Pump	33.95			21.9	7.20	1339	0.26	101		7.3	
07/08/18	1010	Pump	34.80			21.9	7.17	1364	0.18	66.8		-2.5	
07/08/18	1015	Pump	34.85			21.9	7.02	1812	0.06	40.0		-9.1	
07/08/18	1020	Pump	34.90			21.9	7.14	1433	0.10	29.6		-16.1	
07/08/18	1025	Pump	34.90			21.9	7.14	1421	0.08	27.4		-21.3	STOP PUMP TO BAIL
07/08/18	1030	BAIL											
07/08/18	1035	BAIL											
07/08/18	1040	Pump	30.70			22.1	7.40	1621	0.48	145		56.6	Resume Pumping
07/08/18	1045	Pump	33.80			21.9	7.15	1405	0.23	110		20.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW14
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/08/18	1050	Pump	34.30			21.9	7.16	1379	0.16	50.4		2.4	
07/08/18	1055	Pump	33.80			22.1	7.14	1450	0.12	40.0		-6.9	
07/08/18	1100	Pump	33.80			22.1	7.14	1438	0.11	25.4		-12.4	STOP PUMP TO BAIL
07/08/18	1105	~~BAIL~~											
07/08/18	1110	BAIL	31.80			22.5	7.35	1405	0.43	108		58.0	RESUME PUMPING
07/08/18	1115	Pump	32.54			22.1	7.17	1367	0.30	81.4		34.9	
07/08/18	1120	Pump	33.10			22.2	7.18	1364	0.26	59.1		23.7	
07/08/18	1125	Pump	33.65			22.1	7.18	1341	0.19	42.0		16.3	
07/08/18	1130	Pump	33.80			22.1	7.15	1402	0.13	25.3		-0.2	
07/08/18	1135	Pump	33.80			22.1	7.15	1408	0.12	12.3		-4.5	
	~~1140~~					~~22.2~~	~~7.15~~	~~1406~~	~~0.09~~			~~-7.9~~	gm
07/08/18	1140	Pump	33.80			22.2	7.15	1403	0.08	7.56		-13.4	
07/08/18	1145	Pump	33.80			22.2	7.15	1402	0.07	4.34		-16.9	
07/08/18	1150	Pump	33.80			22.2	7.16	1399	0.07	2.05		-23.2	2½ DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW19	Date: 7/4/18		
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116	Recorded By: WTR	Checked By: JM	
EQUIPMENT	Water Quality Meter Type/ID #: YSI 4076 / TURB 6068		Water Level Indicator Type/ID #: Geotech		
	Equipment Group:		Equipment Group:		
	Development Equipment: Turnado Pump		Equipment Decon.: Decon Bucket		
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 25.05		
	Total Well Depth (ft) [d]: 64.45	Water Column Thickness (ft) [d-c]: 39.4'	Well Volume (gal) ([d-c] x b): 32 gallons		
	Ground Condition of Well: Cleared	Remarks:			

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed (mL/L)	Radiation (CKP)	Remarks (odor, clarity, etc.)
7/4/18	0853	Pump	in T		2.0	18.9	6.13	2794	~~7.54~~	743		76.5	START 0850
	0855	Pump	29.70		2.0	18.9	6.15	2766	1.33	466		54.1	Sed Removal
	0900	Pump	32.50		2.0	19.0	6.18	2745	1.69	135		29.4	
	0905	"	30.50		1.0	19.0	6.25	2957	1.68	116		27.6	18 gallons / Surge Pump
	0910	"	30.00		1.0	19.0	6.37	2991	2.21	262		27.7	Sump pump
	0915	Pump	29.85		1.0	19.0	6.21	2874	1.09	89.4		21.0	
	1000	Bailer	surge-block										Surge Bailer
	1025	Pump	26.70		1.0	19.1	6.08	2781	0.99	110		39.3	
	1030	"	27.85		1.0	19.0	6.08	2791	0.55	74.4		30.4	Surge Pump
	1035	P	28.3		1.0	19.1	6.14	2862	0.46	41.7		25.9	
	1040		28.35		1.0	19.2	6.14	2887	0.30	29.4		21.6	Clear
	1045		28.35		1.0	19.2	6.13	2891	0.17	15.7		18.4	Clear 55 gallons

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW19
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation (ORP)	Remarks (odor, clarity, etc.)
7/11/18	1050	Pump	28.00		1.0	19.1	6.13	2891	0.13	9.16		16.7	
	1055	Pump	28.35		1.0	19.2	6.16	2899	0.12	8.53		14.7	
	1100	Pump	28.35		1.0	19.2	6.15	2901	0.10	6.93		12.9	Surge
	1105	Surge	with	Bailer									
	1120	P	26.50		1.0	19.3	6.20	2892	0.63	63.3		31.2	
	1125	P	27.65		1.0	19.3	6.17	2867	0.41	35.6		23.3	≈75 gallons
	1130	P	27.75		1.0	19.3	6.11	2861	0.21	14.2		21.1	Surge Pump
	1135		27.80		1.0	19.2	6.16	2887	0.23	19.8		17.3	
	1140		27.80		1.0	19.2	6.11	2855	0.15	468*		16.5	working bottom*
	1145		27.80		1.0	19.2	6.17	2928	0.13	13.6		14.4	≈95 gallons
	1150		SURGE		with	Bailer							Stop
	1205	P	25.90		1.0	19.6	6.28	2911	0.77	74.1		31.4	
	1210		26.75		1.0	19.3	6.19	2915	0.46	44.9		27.4	
	1215		26.80			19.3	6.17	2920	0.31	27.2		19.9	
	1220		27.20			19.2	6.17	2936	0.23	17.1		16.1	
	1225		27.30			19.3	6.17	2927	0.17	10.9		15.8	110 gallons
	1230		27.40			19.3	6.18	2928	0.14	5.62		14.6	
	1235		27.40			19.2	6.17	2928	0.11	6.44		13.4	
	1240		27.40			19.2	6.17	2922	0.11	5.18		12.1	
	1245		27.35			19.3	6.18	2905	0.10	10.7			Surge Pump

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW19
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) ORP	Remarks (odor, clarity, etc.)
7/11/18	1250	Pump	27.30		1.0	19.3	6.19	2930	0.09	6.90		10.5	
7/11/18	1255	Pump	27.35		1.0	19.1	6.19	2925	0.07	6.19		9.4	
7/11/18	1300	Pump	27.35		1.0	19.2	6.19	2930	0.06	0.02		8.7	
7/11/18	1305	Pump	27.40		1.0	19.1	6.19	2931	0.06	0.46		8.3	
7/11/18	1310	Pump	27.40		1.0	19.1	6.18	2915	0.06	0.02		8.0	Surge Pump 3 DRUMS, 150 GAL

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW21	Date: 07/11/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ 4M4076, TURB #6120		Water Level Indicator Type/ID #: GEOTECH # 5886
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKETS
WELL INFO	Casing I.D. (in) [a]: 2" 2m 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 17.20' BTOC
	Total Well Depth (ft) [d]: 23.93' BTOC	Water Column Thickness (ft) [d-c]: 6.73'	Well Volume (gal) ([d-c] x b): 11.2 GAL
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
~~14~~	1454												JM
07/11/18	1455	Pump	17.8			18.9	7.49	360.9	0.41	>1100		112.0	INT
07/11/18	1500	Pump	19.80			18.0	5.57	813	0.17	>1100		251.5	MOVE PUMP TO BOTTOM FOR SED. REMOVAL
07/11/18	1505	Pump	23.20			17.6	5.50	693	0.16	579		181.5	STOP PUMP TO ALLOW RECHARGE
07/17/18	1155	Pump	17.75			18.4	5.58	2076	1.62	157		71.1	INT
07/17/18	1200	Pump	19.00			17.9	5.38	1522	0.61	43.1		105.8	
07/17/18	1205	Pump	20.10			18.0	5.09	966	1.55	51.9		122.2	
07/17/18	1210	Pump	21.20			18.0	5.18	1219	1.97	82.7		127.7	DEWATER, WAIT FOR RECHARGE
08/21/18	1250	Bail	18.00										SLOW RECHARGE, WILL CHECK TOMORROW
08/21/18	1310	Bail	19.02										~~STOP BAIL, BEGIN PUMPING~~
08/21/18	1325	Pump	19.35			19.1	6.07	1659	6.35	>1100		34.0	STOP BAIL, BEGIN PUMPING
08/21/18	1330	Pump	20.11			19.1	6.00	1641	4.99	>1100		42.3	DARK, RED, OPAQUE

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW21
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/21/18	1335	Pump	21.79			18.9	6.02	1774	3.93	>1100		52.7	DEWATERED, WILL RETURN

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW23	Date: 07/16/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ 4M4076		Water Level Indicator Type/ID #: Geotech # 5886
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 25.05
	Total Well Depth (ft) [d]: 34.92	Water Column Thickness (ft) [d-c]: 9.87	Well Volume (gal) {[d-c] x b}: 17.05
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/16/18	1305	Pump	25.40	2.1	0.42	22.8	6.50	841	0.80	107		51.6	MOVE PUMP TO BOTTOM FOR SEDIMENT REMOVAL
07/16/18	1310	Pump	25.45	|	|	21.6	6.16	831	0.34	>1100		67.6	
07/16/18	1315	Pump	25.72	|	|	20.9	6.23	783	0.21	>1100		63.0	
07/16/18	1325	Pump	25.65	|	|	21.4	6.29	825	0.15	119		56.9	
07/16/18	1335	Pump	25.55	|	|	21.5	6.31	775	0.13	66.3		51.7	SURGE ~~PUMP~~ W/ PUMP
07/16/18	1345	Pump	25.75	|	|	21.1	6.33	819	0.15	167		49.2	
07/16/18	1355	Pump	25.75	|	|	21.1	6.35	811	0.12	41.7		46.8	STOP PUMPING TO BAIL SEDIMENT, 18 GAL. PUMPED
07/16/18	1405	BAIL	25.25	|	|	22.7	6.38	834	0.45	182.0		55.3	STOP BAIL, RESUME PUMPING
07/16/18	1415	Pump	25.60	↓	↓	21.6	6.37	826	0.32	115		51.9	
07/16/18	1425	Pump	25.60	1.25	0.25	21.4	6.38	827	0.28	63.4		50.9	SURGE W/ PUMP
07/16/18	1435	Pump	25.65			21.4	6.39	819	0.24	43.2		48.4	
07/16/18	1445	Pump	25.65			21.2	6.40	814	0.19	40.7		48.2	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW23
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/16/18	1455	Pump	25.65			21.0	6.41	816	0.21	23.6		47.7	
07/16/18	1505	BAIL				21.0	6.42	813	0.20	5.51		47.7	STOP PUMP TO BAIL, 36 GALLONS PUMPED
07/16/18	1515	Pump	25.70			22.8	6.46	811	0.55	333		55.6	STOP BAILING, RESUME PUMPING
07/16/18	1525	Pump	25.65			21.4	6.44	812	0.33	196		54.7	
07/16/18	1535	Pump	25.68			21.2	6.44	797	0.24	101		53.8	
07/16/18	1545	Pump	25.65			21.3	6.44	789	0.22	44.8		52.5	
07/16/18	1555	Pump	25.65			21.2	6.44	789	0.20	33.3		52.6	STOP PUMPING FOR DAY WILL RETURN TOMORROW
07/17/18	0910	Pump	25.50			20.9	7.01	783	1.42	683		105.8	PUMP SED. OFF BOTTOM
07/17/18	0920	Pump	25.90			20.7	6.47	772	0.30	86.3		99.3	
07/17/18	0930	Pump	25.55			20.9	6.46	770	0.22	27.5		96.5	STOP PUMP TO BAIL SED. 56 GALLONS PUMPED
07/17/18	0940	Pump	25.72			20.7	6.51	766	0.41	81.2		97.2	RESUME PUMPING
07/17/18	0950	Pump	25.65			21.1	6.48	766	0.37	86.0		97.6	
07/17/18	1000	Pump	25.40			21.7	6.48	755	0.27	51.9		95.1	
07/17/18	1010	Pump	25.35			21.5	6.49	753	0.30	55.6		93.9	
07/17/18	1020	Pump	25.50			21.2	6.48	747	0.30	37.2		93.8	
07/17/18	1030	Pump	25.10			21.0	6.47	747	0.29	25.1		93.8	
07/17/18	1040	Pump	25.50			21.1	6.48	747	0.27	15.5		93.6	
07/17/18	1050	Pump	25.50			21.0	6.48	744	0.25	10.4		93.7	
07/17/18	1100	Pump	25.50			20.9	6.48	745	0.26	08.37		93.7	
07/17/18	1105	Pump	25.50			21.0	6.48	742	0.24	5.92		93.7	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW23
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/16/18	1110	25.50				21.0	6.48	742	0.25	4.80		93.6	PUMPED 75 GALLONS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47		LocID: 47WW25R		Date: 07/05/2018
	Project Name: Longhorn Army Ammunition Plant		Project #: 10097916		Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ YM 9075			Water Level Indicator Type/ID #: GEOTECH #6162	
	Equipment Group:			Equipment Group:	
	Development Equipment: TORNADO Pump			Equipment Decon.: ALCONOX / BUCKET	
WELL INFO	Casing I.D. (in) [a]: 4"		Unit Casing Volume (gal/lin ft) [b]:		Initial Depth to Water (ft) [c]: 31'
	Total Well Depth (ft) [d]: 42.90		Water Column Thickness (ft) [d-c]: 11.10		Well Volume (gal) ([d-c] x b): 18.62 GAL
	Ground Condition of Well:			Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/05/18	1155	Pump	31.00	3.5	0.7	19.9							INT.
07/05/18	1200	Pump	32.30	↓	↓	19.8	7.20	1324	5.04	>1100		51.2	
07/05/18	1205	Pump	32.90			19.7	7.18	1322	4.96	>1100		34.8	
07/05/18	1210	Pump	32.90			20.1	7.10	1291	4.17	469		1.3	SURGE W/ PUMP
07/05/18	1215	Pump	33.12			19.9	7.06	1306	0.37	829		-7.8	
07/05/18	1220	Pump	33.00			20.0	7.07	1316	0.41	1050		-22.2	
07/05/18	1225	Pump	33.00			20.0	7.01	1320	0.37	636		-25.6	SURGE W/ PUMP
07/05/18	1230	Pump	32.97			20.1	7.05	1368	0.46	940		-37.2	
07/05/18	1235	Pump	33.00			19.8	6.97	1272	0.11	725		-31.3	
07/05/18	1240	Pump	33.00			20.2	6.96	1294	0.16	462		-35.6	
07/05/18	1245	Pump	33.00			19.8	6.97	1294	0.15	462		-40.8	LEAVE FOR DRILLERS TO TAKE LUNCH
07/05/18	1345	~~Pump~~ Bail	31.10	↓	↓								BAIL SEDIMENT

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LWAAP-47	LocID: 47WW25R
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/05/18	1350	BAIL											BAIL SEDIMENT
07/05/18	1355	BAIL	31.7										STOP FOR LIGHTNING
07/05/18	1415	PUMP	32.00	1.5	0.3	20.7	7.51	1325	9.30	>1100		18.8	CONTINUE PUMPING
07/05/18	1420	PUMP	32.39	↓	↓	20.3	7.03	1310	7.20	>1100		-12.4	
07/05/18	1425	PUMP	32.40			20.7	7.03	1333	6.84	>1100		-26.5	
07/05/18	1430	PUMP	32.42			20.4	7.02	1299	6.46	>1100		-37.2	
07/05/18	1435	PUMP	32.50			20.2	7.00	1300	5.91	1010		-42.9	
07/05/18	1440	PUMP	32.50			19.9	6.99	1285	1.93	686		-32.6	
07/05/18	1445	PUMP	32.91			19.9	6.92	1331	1.05	633		-43.6	
07/05/18	1450	PUMP	32.90			20.1	6.96	1299	1.14	447		-45.6	STOP FOR LIGHTNING
07/05/18	1500	PUMP	32.90			20.3	7.26	1299	3.63	~~>1100~~ 268		-1.9	RESUME PUMPING
07/05/18	1505	PUMP	32.25			19.8	6.92	1294	2.58	261		-20.0	
07/05/18	1510	PUMP	33.0			19.8	6.88	1259	1.90	181		-32.2	SURGE W/ PUMP
07/05/18	1515	PUMP	33.0			19.8	6.91	1310	1.83	199		-44.0	
07/05/18	1520	PUMP	33.0			19.9	6.86	1252	1.49	339		-42.5	
07/05/18	1525	PUMP	32.95	↓	↓	19.9	6.87	1265	1.58	139		-44.7	
07/05/18	1530	BAIL											STOP PUMP TO BAIL SEDIMENT
07/05/18	1535	BAIL											
07/05/18	1540	BAIL	32.70			19.7	6.91	1338	1.84	>1100		-20.8	STOP BAILING, START PUMP
07/05/18	1545	PUMP	33.5			20.1	6.91	1340	1.64	>1100		-29.7	SLOW PUMP DOWN

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW25R
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/05/18	1550	Pump	32.71			20.5	6.91	1323	1.34	>1100		-39.5	
07/05/18	1555	Pump	32.71			20.2	6.89	1305	1.07	1000		-42.5	
07/05/18	1600	Pump	32.70			20.5	6.84	1256	0.64	1040		-43.1	
07/05/18	1605	Pump	32.80			19.7	6.81	1258	0.32	559		-40.8	SURGE W/ PUMP
07/05/18	1610	Pump	33.40			19.7	6.91	1333	0.79	732		-53.1	
07/05/18	1615	Pump	33.40			20.1	6.84	1301	0.51	1060		-52.7	
07/05/18	1620	Pump	34.20			19.5	6.94	1404	2.55	>1100		-53.0	STOP PUMP TO BAIL
07/05/18	1625	BAIL											BAIL SEDIMENT
07/05/18	1630	BAIL	32.70										BAIL SEDIMENT
07/05/18	1635	——	31.80										ALLOW RECHARGE
07/05/18	1640	Pump	32.9			20.0	6.77	1279	2.69	>1100		-30.5	
07/05/18	1645	Pump	32.7			19.9							DIDN'T GET READING B/C RAIN/WET PACK
07/05/18	1650	Pump	32.7			20.1	6.77	1282	3.05	>1100		-45.0	STOP FOR DAY
07/06/18	0800	Pump	31.0			19.5	7.92	1354	2.03	106		77.1	INT.
07/06/18	0805	Pump	32.65			19.4	7.11	1340	1.06	303		18.3	SURGE W/ PUMP
07/06/18	0810	Pump	32.80			19.5	7.02	1322	0.73	>1100		4.1	
07/06/18	0815	Pump	32.80			19.7	6.96	1312	0.66	445		-3.4	
07/06/18	0820	Pump	32.50			19.8	6.96	1376	0.76	>1100		-11.5	
07/06/18	0825	Pump	32.70			19.6	6.96	1299	0.52	964		-13.5	
07/06/18	0830	Pump	32.75										

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW25R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/06/18	0835	Pump	32.60			19.7	6.91	1310	0.44	650		-18.9	
07/06/18	0840	Pump	32.70			19.7	6.93	1311	0.41	558		-21.2	
07/06/18	0845	Pump	32.81			19.8	6.96	1342	0.48	494		-27.8	STOP PUMP TO BAIL SED.
07/06/18	0850	Bail											
07/06/18	0855	Bail											
07/06/18	0900	Bail	31.85	1.5	0.3	20.2	7.48	1339	1.73	>1100		-35.4	Resume Pumping
07/06/18	0905	Pump	33.20			20.0	7.02	1403	4.16	>1100		-6.4	
07/06/18	0910	Pump	32.80			19.7	6.92	1299	3.17	472		-12.0	SURGE Pump
07/06/18	0915	Pump	32.80			19.8	6.95	1322	3.36	739		-17.7	
07/06/18	0920	Pump	32.75			19.8	6.96	1354	3.10	656		-21.4	
07/06/18	0925	Pump	32.85			19.8	6.91	1301	2.63	517		-23.1	
07/06/18	0930	Pump	32.90			19.8	6.93	1329	2.47	566		-26.7	
07/06/18	0935	Pump	32.90			19.7	6.89	1294	2.13	668		-26.5	
07/06/18	0940	Pump	32.92			19.8	6.86	1302	0.40	630		-24.5	SURGE Pump
07/06/18	0945	Pump	32.90			19.7	6.94	1320	0.69	550		-33.4	
07/06/18	0950	Pump	32.90			19.7	6.91	1327	0.61	660		-32.8	SURGE Pump
07/06/18	0955	Pump	32.95			19.7	6.94	1330	0.66	597		-36.5	
07/06/18	1000	Pump	33.00			19.4	6.98	1417	1.03	649		-37.6	
07/06/18	1005	Pump	32.65			20.1	6.96	1388	0.85	415		-38.7	
07/06/18	1010	Pump	33.90	↓	↓	19.7	6.88	1385	0.30	407		-36.8	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW25R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/06/18	1015	Pump	32.60			20.2	6.90	1304	0.69	336		-40.4	
07/06/18	1020	Pump	32.50			19.9	6.92	1356	1.06	410		-41.7	
07/06/18	1025	Pump	32.90			19.8	6.92	1305	0.49	377		-41.6	
07/06/18	1030	Pump	33.00			19.7	6.92	1329	0.46	329		-44.8	
07/06/18	1035	Pump	33.00			19.8	6.91	1329	0.37	226		-45.7	
07/06/18	1040	Pump	33.05			19.9	6.90	1318	0.23	363		-44.0	
07/06/18	1045	Pump	32.65			20.1	6.91	1305	0.17	263		-46.5	
07/06/18	1050	Pump	32.90			19.9	6.88	1312	0.25	237		-45.2	
07/06/18	1055	Pump	33.00			19.8	6.91	1310	0.15	203		-48.8	
07/06/18	1100	Pump	32.90			19.9	6.91	1318	0.15	159		-49.0	
07/06/18	1105	Pump	32.80			20.0	6.91	1309	0.13	107		-50.3	
07/06/18	1110	Pump	32.80			19.9	6.91	1309	0.12	78.9		-51.9	
07/06/18	1115	Pump	32.75			20.0	6.92	1313	0.13	57.9		-53.8	
07/06/18	1120	Pump	32.65			20.0	6.91	1323	0.14	46.3		-55.4	
07/06/18	1125	Pump	32.60			20.1	6.91	1319	0.13	40.0		-56.4	
07/06/18	1130	Pump	32.50			20.1	6.92	1323	0.13	39.8		-58.1	
07/06/18	1135	Pump	32.80			19.8	6.91	1327	0.12	40.0		-59.3	
07/06/18	1140	Pump	32.80			19.9	6.91	1326	0.12	40.0		-61.2	
07/06/18	1145	Pump	32.90	↓	↓	19.9	6.92	1329	0.12	40.0		-62.0	~~3~~ ¼ Drums 2¼ Drums

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP	LocID: 47WW26R	Date: 07/03/2018
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: Rae-4M4076, Turb Meter #6120		Water Level Indicator Type/ID #: Geotech #5886
	Equipment Group:		Equpment Group:
	Development Equipment: Tornado Pump & Bailer		Equipment Decon.: Alconox & Bucket
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 29.50' BTOC
	Total Well Depth (ft) [d]: 42.7' BTOC	Water Column Thickness (ft) [d-c]: 12.7	Well Volume (gal) {[d-c] x b}: 19.85
	Ground Condition of Well:		Remarks: Very slow recharge

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/03/18	1440	Pump	31.2										INT.
07/03/18	1445	~~Pump~~	32.21										Stop Pump for Recharge
07/03/18	1450	—	32.19										" "
07/03/18	1455	Pump	33.20			19.4	6.68	2244	0.56	>1100		114.0	
07/03/18	1500	—											Stop Pump For Recharge
07/03/18	1505	Bail											Bail Sed. Off Bottom
07/03/18	1510		34.65										Wait For Recharge
07/03/18	1515		34.19										Wait For Recharge
07/03/18	1520	Pump	34.19										"
07/03/18	1525	—											Wait For Recharge
07/03/18	1530		38.85										
~~07/04/18~~	~~0755~~												Leave to Allow Recharge

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW26R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( )	Remarks (odor, clarity, etc.)
07/04/18	0755	Pump	30.50		0.5	18.4	6.94	2658	2.67	159		122.5	
07/04/18	0800	Pump	33.70		0.5	18.8	6.79	2587	1.98	>1100		121.1	
07/04/18	0805	Pump	37.70		0.5	18.8	6.79	2311	1.96	>1100		118.8	DROP PUMP DOWN TO BOTTOM
07/04/18	0810	Pump	39.60										
07/04/18	0815	——	39.10										STOP PUMP TO LET RECHARGE
07/04/18	0820												" "
07/04/18	1305	INT.	31.19										LEAVE TO RECHARGE, WILL RETURN LATER
07/04/18	1310												CAME BACK TO PUMP AGAIN
07/04/18	1315												PUMP SETUP
07/04/18	1320	Pump	32.50		2.0	18.8	6.79	2717	3.21	>1100		102.6	PUMP SETUP
07/04/18	1325	PUMP	37.50		2.0	18.6	6.87	2446	2.82	>1100		102.0	
07/04/18	1330		38.70										STOP PUMP FOR RECHARGE
7/5/18	0920	Pump	35.89		1.0	18.5	6.77	2275	2.72	>1100		108.8	LEAVE TO RECHARGE
7/5/18	0925	Pump	37.10		0.25	19.2	6.76	2273	2.35	>1100		111.4	DTW = 30.70 - Surge with Bail 2 min
7/5/18	0928												
07/9/18	0900	BAIL	30.75										Developed
07/9/18	0905	BAIL	"										INITIAL, BAIL SEDIMENT
07/09/18	0910	Pump	32.10	1.5	0.3	29.1	7.02	2431	1.13	>1100		80.3	STOP BAILING, START PUMPING
07/09/18	0915	Pump	35.70	1.5	0.3	19.2	6.89	2355	0.84	>1100		59.8	
07/09/18	0920	Pump	38.95	1.5	0.3	19.1	6.92	2332	1.81	>1100		61.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW26R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation (µR/h)	Remarks (odor, clarity, etc.)
7/10/18	1445	TUBING CAME OFF											30.70 INT WL
	1505	Pump	33.0		0.2	19.2	6.75	2316	2.04	121			
	1510	Pump	34.0		0.2	19.4	6.76	2300	2.29	428		56.5	
	1515	Pump	36.0			19.3	6.79	2259	2.65	166		56.2	
	1520	Pump	37.3			19.5	6.83	2283	2.86			56.1	40 gallons
			38.4										Let Recharge
07/13/18	1415	BAIL	30.70										INT.
07/13/18	1420	BAIL											
07/13/18	1425	Pump	31.80	0.5	0.1	19.7	7.62	2296	1.40	259		94.1	STOP BAILING, START PUMPING
07/13/18	1430	Pump	34.35			19.3	7.30	2285	1.28	321		82.3	
07/13/18	1435	Pump	35.20			19.4	7.19	2284	1.26	189		76.8	
07/13/18	1440	Pump	36.40			19.6	7.08	2282	1.35	255		74.6	
07/13/18	1445	Pump	37.40			19.7	7.03	2281	1.44	329		73.8	
07/13/18	1450	Pump	37.95			19.9	6.99	2282	1.48	394		72.9	
07/13/18	1455	Pump		10.0	2.0								DEWATER, WILL RETURN
07/17/18	1315	Pump	30.80			19.8	6.67	2403	1.64	41.3		103.1	
07/17/18	1320	Pump	39.00			18.8	6.72	2345	1.77	36.7		106.7	
			40.85										SHUT OFF PUMP, LET RECHARGE

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW29	Date: 6/27/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: WTR Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: YSI Pro Plus / Geotech turb meter	Water Level Indicator Type/ID #: Geotech 6162	
	Equipment Group:	Equipment Group:	
	Development Equipment: Bailer / Tornado pump	Equipment Decon.: ALConox Bucket	
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 24.45
	Total Well Depth (ft) [d]: 64.84 TOC	Water Column Thickness (ft) [d-c]: 43.39	Well Volume (gal) {[d-c] x b}: 61.4 x3 = 184.2
	Ground Condition of Well:	Remarks: Filter Pack Dr. - 9m	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. ~~(mL/L)~~	~~Radiation~~ Level	Remarks (odor, clarity, etc.)
6/27/18	1415	Pump	27.8		2	19.3	6.88	1693	4.77	22.1		119.4	
6/27		Bailer		6.5									
6/27	1620	Pump	35.83	10	2	18.7	6.32	1515	2.85	84.1		84.6	
6/27	1625	Pump	34.90	10	2	18.8	6.40	1517	2.43	71.6		55.8	WILL LET WELL RECOVER
6/27	1645	Pump	38.35	10	2	19.1	6.28	1331	0.95	317		40.0	Recharge LFT per mn
6/27	1650	Pump	43.50	10	2	18.8	6.34	1337	1.50	58.9		37.0	
~~6/28~~/18	~~0815~~	Pump	29.00	10	2	18.6	6.20	1415	1.97	>1100		125.5	WL 21.50
6/28/18	0820	Pump	31.70	10	2	18.6	6.16	1400	6.68	587		100.0	
6/28	0825	Pump	33.60	10	2	18.7	6.17	1360	0.46	324		75.0	
6/28	0830	pump	34.60	10	2	18.7	6.17	1369	6.30	142		61.8	- Surge pump
6/28	0835		35.23	10	2	18.6	6.17	1408	6.21	96.1		50.7	
6/28	0840		35.41	10	2	18.6	6.19	1378	0.44	91.7		43.5	HIT BOTTOM WITH PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

106.5

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW29
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP	Remarks (odor, clarity, etc.)
6/25/18	0845	Pump	35.75	10	2	18.7	6.25	1270	0.1	176		40.2	START SURGE BLOCK
6/28	0913	Pump	29.19	10	2	18.8	6.14	1366	0.54	296		51.6	WL = 21.93
6/28	0918	Pump	30.80	10	2	18.7	6.07	1476	0.19	155		46.5	
6/28	0923	"	31.80	10	2	18.7	6.15	1276	0.22	128		39.9	
6/28	0928	"	32.33	10	2	18.7	6.16	1349	0.15	45.1		34.9	
6/28	0933		32.65	10	2	18.6	6.16	1357	0.11	27.1		31.2	
6/28	0938		32.81	10	2	18.6	6.17	1362	0.09	22.5		29.5	132 in drums
6/28	0943		32.88	10	2	18.7	6.18	1372	0.29	17.6		27.6	
6/28	0948		32.80	1	2	18.7	6.18	1367	0.15	14.3		26.5	3x55 = 165 gallons
6/28	0953		33.08		2	18.7	6.19	1360	0.13	11.4		24.7	
6/28	0958		33.14			18.7	6.20	1367	0.12	11.3		23.6	
6/28	1003		33.20			18.7	6.20	1375	0.12	11.3		22.6	4th drum over 1/3 full 20 = 185 gallons

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW31	Date: 07/07/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979 16	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ YM 4075		Water Level Indicator Type/ID #: GEOTECH #6162
	Equipment Group:		Equpment Group:
	Development Equipment: TORNADO Pump		Equipment Decon.: ALCONOX / BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 26.55
	Total Well Depth (ft) [d]: 51.90	Water Column Thickness (ft) [d-c]:	Well Volume (gal) {[d-c] x b}: 28.2
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/07/18	1455	Pump	33.10			19.4	7.38	8217	5.12	>1100		ORP 173.1	
07/07/18	1500	Pump	35.10			18.8	7.09	6222	1.52	>1100		58.7	
07/07/18	1505	Pump	40.40			18.7	7.15	6643	1.86	>1100		58.6	
07/07/18	1510	Pump	39.96			19.1	7.00	7177	1.09	>1100		51.4	
07/07/18	1515	Pump	39.70			19.1	6.97	7124	0.93	>1100		41.6	
07/07/18	1520	Pump	39.75			19.1	6.95	7661	0.70	79.5		42.3	
07/07/18	1525	Pump	39.77			19.2	6.90	7135	0.69	77.4		41.8	STOP PUMP TO BAIL
07/07/18	1530	BAIL											
07/07/18	1535	BAIL											
07/07/18	1540	Pump	32.60			22.4	7.61	7157	3.35	178		112.8	STOP BAILING, RESUME PUMPING
07/07/18	1545	Pump	35.10			18.9	6.95	7709	0.66	172		59.6	
07/07/18	1550	Pump	36.40			19.0	6.94	7731	0.57	128		53.0	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW31
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) ORP	Remarks (odor, clarity, etc.)
07/07/18	1555	Pump	36.30	5.0	1.0	19.3	6.92	7798	0.40	116		23.6	Will Return in AM
07/07/18	1600	Pump	36.20	↓	↓	19.2	6.91	7801	0.35			15.8	
07/08/18	1010	Pump	26.70	↓	↓	18.8	7.34	8357	0.55	>1100		90.1	Pump Sed. off Bottom
07/08/18	1015	Pump	32.40	↓	↓	18.8	7.05	8264	0.30	78.8		61.3	
07/08/18	1020	Pump	33.80	↓	↓	18.9	6.98	8295	0.23	46.0		45.5	
07/08/18	1025	Pump	34.25	2.0	0.4	19.1	6.94	8250	0.18	39.8		35.7	
07/08/18	1030	Pump	34.40	↓	↓	19.1	6.93	8196	0.15	28.0		28.5	
07/08/18	1035	Pump	34.40	↓	↓	19.2	6.91	8195	0.13	17.0		25.3	
07/08/18	1040	Pump	34.50	↓	↓	19.2	6.90	8124	0.11	12.0		19.4	
07/08/18	1045	Pump	34.65	↓	↓	19.1	6.89	8104	0.09	8.53		15.0	
07/08/18	1050	Pump	34.65	↓	↓	19.2	6.89	8074	0.08	7.04		13.0	
07/08/18	1055	Pump	34.68	↓	↓	19.2	6.88	8051	0.08	3.46		10.2	Stop Pump to Bail
07/08/18	1100	Bail											
07/08/18	1105	Bail											
07/08/18	1110	Pump	31.70	2.5	0.5	19.9	7.07	7930	0.51	110		31.5	Stop Bailing, Resume Pumping
07/08/18	1115	Pump	32.55	↓	↓	19.2	6.90	7902	0.31	115		23.3	
07/08/18	1120	Pump	33.40	↓	↓	19.2	6.89	7862	0.30	73.2		16.9	
07/08/18	1125	Pump	33.60	↓	↓	19.3	6.88	7850	0.27	66.4		14.2	
07/08/18	1130	Pump	33.83	↓	↓	19.5	6.87	7826	0.24	57.0		13.3	
07/08/18	1135	Pump	33.95	↓	↓	19.3	6.87	7779	0.19	46.8		11.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW31
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979 16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP Radiation ( )	Remarks (odor, clarity, etc.)
07/08/18	1140	Pump	34.00	2.5	0.5	19.3	6.87	7832	0.17	40.0		9.1	
07/08/18	1145	Pump	34.84			19.1	6.87	7827	0.16	36.2		5.9	
07/08/18	1150	Pump	35.62			19.2	6.87	7780	0.14	40.0		-2.4	
07/08/18	1155	Pump	35.80			19.1	6.87	7812	0.14	40.0		-7.5	
07/08/18	1200	Pump	35.85			19.2	6.86	7705	0.13	40.0		-8.1	
07/08/18	1205	Pump	37.76			18.9	6.86	7748	0.15	39.1		-13.2	SURGE W/ PUMP
07/08/18	1210	Pump	38.25			19.1	6.87	7855	0.19	59.5		-18.6	
07/08/18	1215	Pump	37.75			19.3	6.87	7856	0.21	48.7		-19.0	SURGE W/ PUMP
07/08/18	1220	Pump	37.15			19.3	6.86	7628	0.13	40.0		10.6	
07/08/18	1225	Pump	36.90			19.3	6.86	7586	0.11	27.8		3.1	TURN OFF PUMP TO BAIL SED.
07/08/18	1230	Bail											
07/08/18	1235	Bail	33.40										STOP BAILING, RESUME PUMPING
07/08/18	1240	Pump	33.71			20.5	6.98	7571	0.45	67.9		51.3	
07/08/18	1245	Pump	33.95			19.7	6.85	7386	0.19	55.7		14.3	
07/08/18	1250	Pump	34.63			19.7	6.85	7399	0.18	48.7		12.9	
07/08/18	1255	Pump	35.85			19.1	6.86	7660	0.16	40.3		7.0	
07/08/18	1300	Pump	37.05			19.2	6.86	7668	0.17	43.3		1.1	
07/08/18	1305	Pump	37.60			19.1	6.86	7718	0.17	40.0		1.3	
07/08/18	1310	Pump	37.85			19.3	6.87	7547	0.13	32.6		4.6	
07/08/18	1315	Pump	37.95			19.4	6.96	7430	0.10	26.1		-5.7	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47NW31
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/08/18	1320	Pump	38.10			19.4	6.97	7555	0.10	23.1		-16.1	
07/08/18	1325	Pump	38.15			19.4	6.95	7453	0.08	22.6		-13.6	
07/08/18	1330	Pump	38.20			19.4	6.95	7496	0.08	20.5		-17.3	STOP PUMP TO BAIL
07/08/18	1335	Bail											
07/08/18	1340	Bail	35.45			20.3	7.15	7530	0.40	57.4		8.2	STOP BAILING RESUME PUMPING
~~07/08/18~~	~~1345~~	~~Pump~~	~~35.45~~										
07/08/18	1345	Pump	36.40			19.4	7.03	7516	0.22	45.6		-11.3	
07/08/18	1350	Pump	37.05			19.3	7.04	7554	0.17	40.0		-28.7	
07/08/18	1355	Pump	37.55			19.3	7.11	7542	0.14	32.0		-35.7	
07/08/18	1400	Pump	37.80			19.3	7.13	7502	0.13	31.0		-48.6	
07/08/18	1405	Pump	38.05			19.2	7.13	7448	0.10	28.7		-49.8	
07/08/18	1410	Pump	38.15			19.3	7.13	7381	0.09	20.2		-53.5	
07/08/18	1415	Pump	38.20			19.3	7.16	7414	0.08	15.2		-59.8	
07/08/18	1420	Pump	38.20			19.3	7.14	7401	0.07	9.38		-63.0	
07/08/18	1425	Pump	38.20			19.3	7.14	7393	0.05	6.64		-66.6	
07/08/18	1430	Pump	38.20			19.2	7.14	7390	0.05	2.74		-68.2	
07/08/18	1435	Pump	38.20			19.3	7.15	7359	0.04	1.75		-75.6	
07/08/18	1440	Pump	38.20			19.2	7.13	7304	0.04	0.02		-79.7	
07/08/18	1445	Pump				19.3	7.12	7344	0.04	0.02		-81.1	2 3/4 DRUMS = 150 GAL

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

JM

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW32		Date: 7/5/18	
	Project Name: Longhorn Army Ammunition Plant	Project #: 100797.16		Recorded By: WTR	Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: YSI 4076 / Turbo 6282		Water Level Indicator Type/ID #: Geotech C1.48		
	Equipment Group:		Equipment Group:		
	Development Equipment: Tornado pump		Equipment Decon.: Alconox & Buckets		
WELL INFO	Casing I.D. (in) [a]: 2	Unit Casing Volume (gal/lin ft) [b]:		Initial Depth to Water (ft) [c]: 24.00	
	Total Well Depth (ft) [d]: 35.25	Water Column Thickness (ft) [d-c]: 11.25		Well Volume (gal) ([d-c] x b): 5.85	
	Ground Condition of Well: Cleared		Remarks: used pump AS SURGE BLOCK		

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed (mL/L)	Radiation cpm	Remarks (odor, clarity, etc.)
7/5/18	1550	Pump	25.55	INT	0.25	20.0	6.59	8418	1.27	336		174.6	Clear
7/5/18	1555	Pump	26.10	2.5	0.5	18.8	6.58	8392	0.86	>1100		172.	+ Remove Sed from Bottom
7/5/18	1600	"	26.80	2.5	0.5	18.6	6.60	8423	0.82	~~53.6~~	106	171.6	SURGE WITH PUMP
7/5/18	1605	"	26.90	2.5	0.5	19.0	6.62	8194	0.53	276.0		170.0	
	1610	"	26.90	2.5	0.25	19.1	6.63	8175	0.26	72.6		167.9	SURGE PUMP
	1625	"	26.55	1.25	0.25	19.0	6.67	8218	1.47	316		164.5	
	1630		27.30	1.25	0.25	18.6	6.66	8184	0.42	160		162.8	
	1635		26.60			19.4	6.67	7849	0.29	129		161.5	
	1640		26.40			19.1	6.67	7906	0.23	89.6		160.6	
	1645		26.40			19.2	6.67	7904	0.22	42.90		160.1	STOP FOR the DAY
7/6/18	0800												DTW = 24.05
7/6/18	0815		25.61		0.25	18.8	6.66	7777	2.18			173.0	START OSIL / SURGE PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW32
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP	Remarks (odor, clarity, etc.)
~~8/16/07~~	0820	Pump	~~26.75~~		0.25	18.8	6.71	7980	2.04	226		168.5	18 gallons
	0830	"	26.85		0.25	18.7	6.74	7987	1.22	—		165.5	
	0835		27.46		0.25	18.4	6.71	7894	0.99	266		166.4	
	0840				~~0.25~~								Surge
	0845		27.10		0.25	18.6	6.72	7614	0.88	120		163.2	
	0850		27.10		0.25	18.7	6.71	7752	0.98			162.8	
	0855		27.31			18.7	6.71	7567	0.50			162.1	
	0												Pump off 5 min/Surge
	0910		26.81			18.7	6.73	8073	2.51	325		161.2	≈25 gallons
	0915		26.95			18.9	6.72	7786	0.59	188		160.2	
	0920		26.24			20.6	6.72	7740	0.66	980		159.4	
	0925					18.3	6.73	7744	1.60	>1100		159.0	Surge Button
	0935		27.60			18.6	6.72	7725	1.07	113		158.0	Surge pump
	0940		27.90			18.8	6.75	7689	1.68	243		157.7	Let Recharge
	0945		27.05			18.9	6.75	7258	0.71	691		156.7	
	0950		26.82			18.9	6.74	7576	2.51	>1100		156.4	
	0955		26.92			18.8	6.74	7624	1.31	214		156.4	
	1000		26.96			18.9	6.72	7600	0.93	283		155.7	cleaned up Fast/~~Slow~~
	1005		27.02			19.0	6.72	7614	0.77	190		154.9	Surge pump
	1015		27.12			18.7	6.73	7581	1.75	610		153.7	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MULT cycles for pump/shut off pump/surge/pump

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW32
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ORP	Remarks (odor, clarity, etc.)
7/6/18	1020	Pump	27.60		~0.25	18.7	6.72	7701	0.89	36.8		153.1	Surge Pump
7/6/18	1025	"	27.84		~0.25	18.7	6.72	7437	0.85	>1000		152.6	
	1030	"	27.84		~0.25	18.7	6.72	7685	0.69	112		153.0	
	1035	"	27.92		"	18.7	6.72	7540	0.32	35.5		152.1	
	1040	"	25.30		"	18.6	6.72	7530	0.32	10.6		152.1	Pump off to recharge
	1050		26.6		"	18.8	6.74	7571	1.22	157		149.9	Surge with pump 55 gal
	1055		27.1		"	18.7	6.73	7734	2.06	130		150.2	
	1100		27.43		"	18.8	6.73	7603	0.84	65.9		149.8	
	1105		27.50		"	19.1	6.73	7514	0.62	26.3		148.9	
	1110		27.56		"	18.9	6.73	7536	0.59	12.6		148.4	
	1115		27.60		"	18.9	6.73	7515	0.52	9.22		147.9	
	1120		27.54		"	18.9	6.73	7468	0.46	4.17		146.8	
	1125		27.50		"	19.0	6.73	7543	0.46	2.65		146.3	
	1130		27.52		"	18.9	6.73	7501	0.44	2.31		145.8	70 gallons total
													2 DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW33	Date: 7/5/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16	Recorded By: WTR Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: YSI 4076 Geotech 6282		Water Level Indicator Type/ID #: Geotech 6148
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP		Equipment Decon.: Bucket / ALCONOX
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 12.20
	Total Well Depth (ft) [d]: 37.20	Water Column Thickness (ft) [d-c]: 24.5	Well Volume (gal) ([d-c] x b): 22.62 gallon SOP
	Ground Condition of Well: Clear-cd		Remarks: F-1kr pack = 12 ft SL = 10 22.62 gallons 8 in borehole

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. ~~(mL/L)~~	Radiation ( )	Remarks (odor, clarity, etc.)
7/5/18	1045	Pump	13.60			17.9	5.05	1510	0.76	299		123.5	orange
7/5/18	1050	Pump	14.30	10	2.0	17.8	5.18	1616	0.40	329		116.0	Surging Bottom
7/5/18	1055	Pump	14.35	10	2.0	17.8	5.19	1603	2.2	112		119.2	START SURGING BAILER
7/5/18	1115	"	13.90	1.6	2.0	18.0	5.13	1223	0.25	1100		127.2	
7/5	1120	Pump	14.15	10	2.0	17.2	5.23	1532	0.18	7/100		~~126.5~~	
7/5	1125	Pump		1.0	2.00	17.7	5.02	1655	0.17	7/100		128.3	
7/5	1130	Pump	14.20	10	2.0	17.8	5.19	1546	0.16	476		128.6	55 gallons
7/5	1135	Pump	14.35	10	2.0	17.8	5.27	1595	0.08	291		126.5	Surge with Bailer
7/5	1140	Pump	14.20	10	2.0	18.0	5.42	1798	0.26	925		120.9	
7/5	1155	"	14.20	10	2.0	17.8	5.25	1582	0.11	387		125.3	
7/5	1200	"	13.53	5	1.0	18.0	5.27	1649	0.07	279		122.4	START SURGE
	1220		13.4			17.9	5.30	1554	1.6	838		122.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW33
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( )	Remarks (odor, clarity, etc.)
7/5	1225	Pump	13.7	5	1	18.3	5.32	1613	0.11	33.5		117.2	
	1230		13.1	5	1	18.2	5.32	1610	0.09	30.3		117.2	
	1235		13.14	5	1	18.2	5.32	1627	0.08	25.9		115.8	
	1240		13.14	5	1	18.2	5.33	1611	0.09	18.6		115.1	
	1245		13.15	5	1	18.1	5.33	1636	0.07	13.5		116.6	
	1250		13.15	5	1	18.3	5.27	1243	0.09	10.8		113.4	
	1255		13.15	5	1	18.3	5.32	1583	0.09	11.2		118.4	Cloudy
	1300		12.95	5	1	18.3	5.34	1614	0.07	89.6		118.5	surge Pump
	1305		12.95	5	1	18.2	5.25	1430	0.07	92.8		121.0	
	1310		12.95	5	1	18.2	5.34	1604	0.07	87.0		120.5	
	1315		12.95	5	1	18.2	5.34	1620	0.07	84.6		120.2	
	1320		12.99	5	1	18.2	5.34	1608	0.07	76.0		120.0	
	1325		12.95	5	1	18.2	5.34	1599	0.07	62.5		120.6	
	1330		12.95	5	1	18.1	5.34	1611	0.07	53.2		120.9	
	1335		12.95	5	1	18.1	5.33	1621	0.07	48.9		121.4	
	1340		12.98	5	1	18.1	5.34	1611	0.07	45.9		121.7	
	1345		12.98	5	1	18.1	5.34	1628	0.07	42.0		121.8	
	1350		12.95	5	1	18.0	5.33	1617	0.06	32.5		121.9	
	1355		13.00	5	1	18.0	5.33	1608	0.06	37.5		122.8	
	1400		13.00	5	1	18.0	5.33	1609	0.06	33.6		122.7	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW33
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation (cpm)	Remarks (odor, clarity, etc.)
7/5/16	1405	Pump	13.00	5	1	18.1	5.39	1635	0.06	3x2		122.9	
↓	1410	Pump	12.6	5	1	18.1	5.35	1642	0.06	31.0		122.9	
	1415	Pump	13.00	5	1	18.1	5.34	1628	0.05	26.6		122.6	
	1420	Pump	13.00	5	1	18.1	5.34	1620	0.06	26.6		123.0	
	1425	Pump	13.00	5	1	18.1	5.34	1620	0.06	26.6		122.0	175 gallons
													3 Full Drums +10

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW34	Date: 6/28/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: WTR Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: YSI / Geotech TURB		Water Level Indicator Type/ID #: Geotech #6162
	Equipment Group:		Equipment Group:
	Development Equipment: Tornado pump / controller Box on 6/28/18		Equipment Decon.: Bucket liq.
WELL INFO	Casing I.D. (in) [a]: 47WW34	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 20.10
	Total Well Depth (ft) [d]: 46.45	Water Column Thickness (ft) [d-c]: 26.35	Well Volume (gal) ([d-c] x b): 33 gallon ~~50.6 gallon~~ WTR (WTR 157.8)
	Ground Condition of Well: OVERGROWN		Remarks: Recalculated well volume - HAD WRONG # in FORMULA

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( ) ORP	Remarks (odor, clarity, etc.)
6/28/18	1150	Pump	30.4	10	2	18.9	6.98	1366	3.64	7.33		136.1	Clear 26.7
6/28/18	1252	Pump	34.49	10	2	19.5	6.75	1349	3.85	>1100		116.9	0.5ft in 1.5 min
6/28	1257	Pump	36.0	6 3min	2	19.5	6.74	1398	2.68	>1100		114.3	Orange will let Recharge
6/28	1353	↓	25.63	6	2	19.2	6.59	1321	3.37	465		126.6	WL=29.30
6/28	1357		29.30	6	2	19.2	6.62	—	1.44	482		124.6	let recharge
6/28	1408		32.7	6	2	19.2	6.64	1300	1.33	937		123.3	27 -
6/28	1422		34.25	6	2	19.1	6.79	1266	6.88	452		108.8	27 40 gallons
6/28	1448		31.75	↓	↓	19.1	6.56	1280	0.99	129		127.3	23.
6/28	1457		32.90			19.1	6.62	1268	0.32	83.8		121.3	45 gallon
6/28	1506		32.00			19.1	6.70	1362	0.52	79.9		114.8	recharge to 26.92 55 gallons
6/28	1525		32.60			19.2	6.59	1285	2.54	786		121.0	Surge with Baler 26.10
6/28	1532	↓	32.00	↓	↓	19.0	6.69	1271	0.80	231		117.0	2

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW34
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation (clean)	Remarks (odor, clarity, etc.)
6/28/18	1547	P	32.40	3 min purge		19.1	6.70	1336	0.80	157		112.2	WL=27.75
6/28/18	1601	P	33.10	3 min purge		18.9	6.77	1261	0.90	107		110.4	WL=27.30 73gallons
6/28	1623		32.90			19.1	6.94	1265	0.62	221		107.1	WL=26.25
6/28	1640		30.07			19.0	6.55	1276	0.66	124		121.4	WL=24.90
6/28	1652		29.72			19.1	6.75	1259	0.38	46.1		112.4	26.3
6/28	1700		30.05			19.5	6.86	1269	0.38	40.6		110.1	26.53 1.5 Drums 2 L NaOH
6/29/18	0755		23.59	3.75	0.75	18.8	6.55	1272	1.78	7/100		159.1	Surged with SB DTW 20.10
6/29	0800		25.00	3.75	0.75	18.8	6.59	1240	0.70	582		179.3	Sheen 1 2/3 drums
6/29	0805		30.15	3.75	0.75	19.1	6.63	1276	0.58	260		193.4	
6/29	0831		24.80	3.75	0.5	19.2	6.65	1260	0.45	100		163.6	
6/29	0836		26.40	3.75	0.5	19.1	6.63	1247	0.32	36.5		163.0	clear
6/29	0841		26.90	3.75	0.5	19.3	6.65	1255	0.34	45.0		160.9	clear
6/29	0846		27.24	3.75	0.5	19.3	6.67	1262	0.33	37.1		158.8	clear
6/29	0851		27.50	3.75		19.3	6.70	1269	0.31	31.4		156.7	110 gallons
6/29	0856		27.95	3.75		19.3	6.71	1269	0.31	21.7		156.6	
6/29	0901		27.91	3.75		19.3	6.70	1270	0.32	29.3		155.0	
6/29	0906		28.30	3.75		19.3	6.71	1273	0.26	24.8		154.2	
6/29	0911		28.40	3.75		19.4	6.71	1278	0.25	24.7		153.8	
6/29	0916		28.50	3.75		19.4	6.72	1277	0.25	25.4		153.0	120 gallons total

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

Using variable speed (6/29/18)

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW35	Date: 07/12/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ YN4075		Water Level Indicator Type/ID #: GEOTECH # 5886
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAIL		Equipment Decon.: ALCONOX / BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 21.0
	Total Well Depth (ft) [d]: 49.0	Water Column Thickness (ft) [d-c]: 28	Well Volume (gal) {[d-c] x b}: 28.7
	Ground Condition of Well: SOFT/MUDDY		Remarks:

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/12/18	0825	Pump	21.0	2.5	0.5	19.1	7.59	6399	2.43	>1100		0.9	WHITE SUBSTANCE IN WELL
07/12/18	0830	Pump	27.14	↓	↓	19.3	9.92	6157	7.12	181		-5.2	
07/12/18	0835	Pump	29.00			19.4	9.14	6470	4.44	282		1.7	
07/12/18	0840	Pump	29.60			19.7	7.24	6672	2.55	207		-29.1	
07/12/18	0845	Pump	30.60			19.5	7.11	6603	2.67	147		-32.9	SURGE W/ PUMP
07/12/18	0850	Pump	31.94			19.6	6.90	6654	0.47	>1100		-76.0	
07/12/18	0855	Pump	34.80			19.4	6.89	6561	1.83	499		-22.5	
07/12/18	0900	Pump	34.50	↓	↓	19.5	6.78	6574	1.07	386		-16.2	STOP PUMP TO BAIL SEDIMENT
07/12/18	0905	Bail				~~19.3~~	~~6.81~~	~~6467~~	~~1.54~~			~~-16.2~~	
07/12/18	0910	Bail	36.10	2.5	0.5	19.3	6.81	6467	1.54	>1100		-16.2	RESUME PUMPING
07/12/18	0915	Pump	37.05	↓	↓	19.3	6.78	6455	1.76	>1100		-21.7	
07/12/18	0920	Pump	39.00	↓	↓	19.3	6.76	6445	1.82	>1100		-23.0	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW135
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/12/18	0925	Pump	38.30	2.5	0.5	19.7	6.57	6474	0.90	>1100		-12.9	
07/12/18	0930	Pump	38.20			19.6	6.50	6471	0.67	995		-11.9	
07/12/18	0935	Pump	38.20			19.6	6.45	6467	0.45	669		-11.8	
07/12/18	0940	Pump	38.20			19.5	6.44	6464	0.45	872		-12.5	
07/12/18	0945	Pump	39.45			19.4	6.39	6495	0.23	814		-12.3	STOP PUMP TO BAIL SEDIMENT
07/12/18	0950	BAIL											
07/12/18	0955	BAIL	38.72			19.5	6.55	5660	0.53	>1100		0.5	
07/12/18	1000	Pump	38.95			19.6	6.41	6359	0.43	>1100		-1.1	
07/12/18	1005	Pump	39.10			19.6	6.41	6422	0.42	>1100		-4.1	
07/12/18	1010	Pump	39.70			19.5	6.39	6465	0.25	662		-9.1	SURGE W/ PUMP
07/12/18	1015	Pump	38.60			20.5	6.41	4778	0.45	>1100		-3.3	
07/12/18	1020	Pump	40.70			19.2	6.56	3416	0.26	>1100		-10.6	
07/12/18	1025	Pump	40.65			19.4	6.56	3544	0.47	>1100		-12.6	SURGE W/ PUMP
07/12/18	1030	Pump	40.70			19.4	6.44	4853	0.41	>1100		-9.2	
07/12/18	1035	Pump	40.3			19.7	6.41	6387	0.35	>1100		-14.3	
07/12/18	1040	Pump	39.7			19.6	6.39	6379	0.27	>1100		-16.6	SURGE W/ PUMP
07/12/18	1045	Pump	40.1			19.6	6.36	6337	0.10	>1100		-16.3	STOP PUMP TO BAIL
07/12/18	1050	BAIL											
07/12/18	1055	BAIL											STOP BAILING, RESUME PUMPING
07/12/18	1100	Pump	37.0			19.4	6.34	6357	0.22	>1100		-1.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW35
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/12/18	1105	Pump	38.90	2.5	0.5	19.5	6.35	6364	0.37	>1100		-5.5	
07/12/18	1110	Pump	38.90			19.5	6.35	6358	0.35	501		-5.4	
07/12/18	1115	Pump	40.00			19.4	6.34	6352	0.34	313		-7.3	SURGE PUMP
07/12/18	1120	Pump	38.65			19.8	6.34	6372	0.47	>1100		-11.8	
07/12/18	1125	Pump	38.30			19.6	6.34	6358	0.23	504		-16.0	
07/12/18	1130	Pump	38.02			19.6	6.35	6348	0.17	159		-16.8	
07/12/18	1135	Pump	38.40			19.6	6.36	5339	0.12	65.1		-18.3	SURGE W/ PUMP
07/12/18	1140	Pump	38.52			19.6	6.36	6344	0.18	714		-19.3	
07/12/18	1145	Pump	38.02			19.8	6.37	6343	0.20	506		-22.6	
07/12/18	1150	Pump	37.35			19.7	6.40	6355	0.15	152		-25.1	
07/12/18	1155	Pump	37.50			19.5	6.40	6346	0.08	56.7		-26.6	SURGE W/ PUMP
07/12/18	1200	Pump	37.55			19.4	6.38	6338	0.22	98.3		-24.9	
07/12/18	1205	Pump	37.75			19.4	6.38	6340	0.13	155		-24.8	
07/12/18	1210	Pump	38.05			19.4	6.36	6333	0.10	212		-24.4	
07/12/18	1215	Pump	38.00			19.4	6.35	6333	0.10	46.8		-23.9	SURGE W/ PUMP
07/12/18	1220	Pump	38.14			19.6	6.35	6336	0.11	422		-24.0	
07/12/18	1225	Pump	38.40			19.6	6.35	6353	0.15	65.0		-18.7	
07/12/18	1230	Pump	37.80			19.7	6.32	6360	0.09	29.8		-18.7	
07/12/18	1235	Pump	37.43			19.5	6.32	6345	0.06	21.5		-18.8	
07/12/18	1240	Pump	38.50			19.5	6.32	6350	0.12	40.0		-18.5	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW35
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/12/18	1245	Pump	39.0	2.5	0.5	19.4	6.31	6365	0.14	40.0		-18.7	
07/12/18	1250	Pump	38.4			19.4	6.30	6363	0.12	40.0		-18.6	
~~07/12/18~~	~~0750~~	~~pm~~											STOP FOR LIGHTNING
07/13/18	0750	Pump	20.80			19.0	6.50	6396	0.33	110		-42.3	INT.
07/13/18	0755	Pump	29.35			19.1	6.50	6395	0.20	37.0		-41.6	
07/13/18	0800	Pump	30.20			19.2	6.38	6385	0.17	29.7		-34.9	
07/13/18	0805	Pump	31.30			19.2	6.33	6373	0.14	31.7		-33.1	
07/13/18	0810	Pump	31.30			19.3	6.28	6363	0.13	57.4		-31.7	
07/13/18	0815	Pump	31.52			19.3	6.24	6353	0.10	20.7		-29.7	
07/13/18	0820	Pump	31.80			19.4	6.22	6347	0.09	18.3		-28.4	
07/13/18	0825	Pump	32.00			19.4	6.20	6339	0.08	20.0		-27.2	
07/13/18	0830	Pump	32.05			19.4	6.19	6337	0.08	14.1		-26.7	
07/13/18	0835	Pump	32.06			19.4	6.18	6333	0.08	10.6		-26.5	
07/13/18	0840	Pump	32.08			19.4	6.18	6331	0.08	10.1		-26.5	
07/13/18	0845	Pump	32.06			19.4	6.18	6329	0.08	9.87		-27.0	
07/13/18	0850	Pump	32.20			19.5	6.18	6326	0.08	7.79		-26.9	
07/13/18	0855	Pump	32.30			19.5	6.17	6325	0.08	7.73		-26.7	170 GALLONS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

47WW36

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47		LocID: 47WW36		Date: 7/11/18 WTK 7/12/18
	Project Name: Longhorn Army Ammunition Plant		Project #: 10097916		Recorded By: WTK Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: YSI-4076 TURB 6252			Water Level Indicator Type/ID #: Geotech	
	Equipment Group:			Equipment Group:	
	Development Equipment: TORNADO PUMP			Equipment Decon.: ALCO / Bucket	
WELL INFO	Casing I.D. (in) [a]: 4		Unit Casing Volume (gal/lin ft) [b]:		Initial Depth to Water (ft) [c]: 23.00
	Total Well Depth (ft) [d]: 33.20		Water Column Thickness (ft) [d-c]: 10.2'		Well Volume (gal) ([d-c] x b): 15.4 gallons
	Ground Condition of Well: Overgrown / needs clearing			Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date 7/10/18	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ORP	Remarks (odor, clarity, etc.)
0845	0845	Pump				19.3	12.84	12446	7.68	27.6			
7/12/18	0850	↓				18.7	12.84	12331	7.94			122.9	Need to recalibrate
7/12/18	0930	↓	28.3			18.7	12.83	12156	7.45	4.75		160.9	meter
	0935		30.90	3.90		19.0	12.85	12258	7.47	5.06		153.9	Return 0945 WL=25.90
	0938	Dewatered WELL				- slow or no Recharge							
7/13/18	—	DRY											

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

DRY

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47		LocID: 47WW37	Date: 07/10/18	
	Project Name: Longhorn Army Ammunition Plant		Project #: 100979916	Recorded By: JM	Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+YM4075			Water Level Indicator Type/ID #: GEOTECH # 6162	
	Equipment Group:			Equipment Group:	
	Development Equipment: TORNADO Pump			Equipment Decon.: ALCONOX/BUCKET	
WELL INFO	Casing I.D. (in) [a]: 2"		Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 32.7' BTOC	
	Total Well Depth (ft) [d]: 67.0' BTOC		Water Column Thickness (ft) [d-c]: 34.3	Well Volume (gal) ([d-c] x b): 9.48 GAL	
	Ground Condition of Well:			Remarks:	

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/10/18	1340	Pump	32.7			19.6	12.97	10767	6.62	>1100		-130.3	INT
07/10/18	1345	Pump	57.9			19.7	13.01	9455	4.38	>1100		-157.4	
07/10/18	1350	Pump	56.3			24.6	12.74	8832	4.03	13.9		-160.1	
07/10/18	1355	Pump	57.6			21.1	10.63	1279	0.08	>1100		-171.4	DARK, BLACK MUD
07/10/18	1400	Pump	60.5			20.5	11.24	1892	1.34	>1100		-169.7	SURGE W/ PUMP
07/10/18	1405												STOP PUMP FOR RECHARGE
~~07/10/18~~	~~1410~~	~~Pump~~	~~49.15~~										
07/10/18	1415	Pump	49.15			19.9	9.57	1414	0.28	>1100		-159.8	REMAIN PUMPING
07/10/18	1420	Pump	57.10			19.9	9.25	1456	0.66	>1100		-157.6	
07/10/18	1425	Pump	56.90			20.6	9.07	1394	0.78	219		-152.6	SURGE W/ PUMP
07/10/18	1430	Pump	56.94			20.7	8.83	1515	1.37	820		-136.8	
07/10/18	1435	Pump	57.31			21.0	9.21	1374	0.40	800		-165.4	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: ~~47WW32~~ 9M 47WW37
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
~~1440 9M~~	1440	Pump	57.13										9M
07/10/18	1440	Pump	57.13			21.0	9.19	1383	0.46	144		-171.2	
07/10/18	1445	Pump	57.14			20.8	9.16	1415	0.36	90.4		-173.3	SURGE W/ PUMP
07/10/18	1450	Pump	59.60			20.5	8.66	1269	0.32	380		-172.0	
~~07/10/18~~	~~1455~~	~~Pump~~	~~59.60~~										9M
07/10/18	1455	Pump	60.00			20.9	8.60	1411	0.60	90.9		-181.9	
07/10/18	1500	Pump	58.51			21.5	8.77	1370	0.54	59.2		-182.1	
07/10/18	1505	Pump	59.50			20.7	9.33	1534	0.55	40.0		-188.6	
07/10/18	1510	Pump	59.90			20.8	8.69	1417	0.98	401		-176.6	SURGE W/ PUMP
07/10/18	1515	Pump	59.70			21.0	8.62	1442	0.76	36.3		-188.7	
07/10/18	1520	Pump	59.73			20.9	8.83	1446	0.75	21.4		-179.5	
07/10/18	1525	Pump	59.20			21.1	8.78	1385	0.75	05.63		-176.6	
07/10/18	1530	Pump	57.41			21.9	8.81	1429	0.79	0.02		-168.6	SURGE W/PUMP
07/10/18	1535	Pump	58.30			20.8	8.44	1232	0.54	112		-173.2	
07/10/18	1540	Pump	58.73			20.7	8.58	1256	0.56	40.0		-168.6	
07/10/18	1545	Pump	59.10			20.9	8.24	1208	0.39	33.7		-169.1	
07/10/18	1550	Pump	59.20			21.1	8.10	1427	0.50	>1100		-173.2	DARK, BLACK COLORED HEAVY SAND
07/10/18	1555	Pump	60.02			20.6	7.99	1475	4.61	35.2		-136.7	STOP PUMP FOR RECHARGE
07/10/18	1600	Pump	54.80			20.2	8.27	1297	0.50	28.7		-146.1	RESUME PUMPING
07/10/18	1605	Pump	62.90			20.8	8.39	1454	2.19			-142.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW37
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979/6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/10/18	1610	Pump	62.70			20.8	8.30	1249	0.47	0.46		-114.0	DARK HEAVY SAND, NOT ENOUGH PRESSURE TO PUMP OUT
07/10/18	1615									~~>1100~~ JM			STOP PUMP TO RECHARGE
07/10/18	1620	Pump	60.00			20.2	8.60	1268	1.42	>1100		-124.7	RESUME PUMPING, SURGE W/ PUMP
07/10/18	1625												
07/10/18	1630												
07/10/18	1635	Pump				19.9	8.40	1490	2.04	132		-136.4	STOP PUMP TO ALLOW RECHARGE
07/11/18	0806	Pump	32.00	0.18	0.9								LOST HOSE CAME UNBONE
07/11/18	0820	Pump	35.25	0.18	0.9	19.7	8.49	1364	~~1362.88~~ JM 80.6			-5.0	ATTATCH HOSE, RESUME PUMPING
07/11/18	0825	Pump	42.10			20.1	8.62	1397	1.06	65.6		-45.3	
07/11/18	0830	Pump	42.50			20.7	8.50	1370	0.97	51.0		-65.4	
07/11/18	0835	Pump	42.60			20.7	8.46	1344	0.83	53.8		-87.7	
07/11/18	0840	Pump	43.70			20.5	8.52	1340	0.59	52.4		-118.1	
07/11/18	0845	Pump	43.60			20.7	8.37	1396	0.56	89.1		-112.4	SURGE W/ PUMP
07/11/18	0850	Pump	46.00			20.7	8.56	1411	0.48	134		-147.1	
07/11/18	0855	Pump	46.70			20.5	8.72	1418	0.62	140		-116.2	SURGE W/ PUMP
07/11/18	0900	Pump	52.30			19.9	8.65	1503	0.90	116		-158.7	
07/11/18	0905	Pump	54.20			20.3	8.37	1417	0.71	53.7		-142.8	
07/11/18	0910	Pump	54.23			20.6	8.48	1391	0.54	36.2		-151.7	
07/11/18	0915	Pump	54.30			20.5	8.57	1393	0.38	25.5		-165.6	
07/11/18	0920	Pump	54.30	↓	↓	20.5	8.58	1392	0.31	33.5		-168.3	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW37
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/11/18	0925	Pump	54.22	0.18	0.9	20.5	8.60	1421	0.28	31.2		-176.4	
07/11/18	0930	Pump	54.74			20.4	8.55	1420	0.25	24.1		-168.7	
07/11/18	0935	Pump	55.00			20.5	8.43	1432	0.26	15.8		-162.7	SURGE W/ PUMP
07/11/18	0940	Pump	59.20			20.1	8.02	1465	0.59	38.9		-143.6	
07/11/18	0945	Pump	60.22			20.3	8.02	1477	0.88	33.1		-134.4	
07/11/18	0950	Pump	59.20			20.5	8.04	1430	0.74	18.6		-123.2	
07/11/18	0955	Pump	59.00			20.6	8.29	1407	0.53	11.4		-144.6	
07/11/18	1000	Pump	58.49			20.5	8.44	1436	0.40	07.85		-156.4	SURGE W/ PUMP
07/11/18	1005	Pump	58.80			21.0	8.37	1455	0.46	23.0		-154.3	
07/11/18	1010	Pump	59.00			20.4	8.02	1379	0.56	16.3		-131.7	
07/11/18	1015	Pump	59.00			20.4	8.18	1405	0.41	10.7		-147.1	
07/11/18	1020	Pump	59.40			20.4	8.25	1441	0.36	08.16		-157.6	
07/11/18	1025	Pump	59.60			20.5	8.16	1432	0.36	6.79		-150.6	SURGE W/ PUMP
07/11/18	1030	Pump	62.00										STOP FOR RECHARGE
07/11/18	1035	Pump	56.10			19.9	8.22	1487	0.92	28.6		-147.2	RESUME PUMPING
~~07/11/18~~	~~1040~~									~~28.6~~			JM
07/11/18	1040	Pump	63.80			20.1	8.02	1488	1.36			-127.6	
07/11/18	1045	Pump	64.85			20.2	8.14	1408				-104.9	SHUT DOWN FOR RECHARGE
07/11/18	1055	Pump	64.20										RESUME PUMPING
07/11/18	1100												DEWATER WELL, LEAVE TO RECHARGE OVERNIGHT

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW37
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/28/18	1010	Pump	36.29			21.1	8.30	1484	2.55	33.7		148.1	SURGE W/ PUMP
08/28/18	1015	Pump	37.00	73.0		22.8	8.29	1475	1.95	21.2		129.1	
08/28/18	1020	Pump	37.70			21.5	8.27	1450	1.64	60.0		117.1	
08/28/18	1025	Pump	39.55			21.6	8.21	1421	1.25	16.7		88.5	
08/28/18	1030	Pump	39.22			22.5	8.19	1426	1.16	14.7		62.2	
08/28/18	1035	Pump	39.99			22.3	8.08	1415	1.03	8.49		28.4	SURGE W/ PUMP
08/28/18	1040	Pump	40.30			22.3	8.02	1395	0.85	13.0		-36.4	
08/28/18	1045	Pump	41.04			21.8	8.07	1430	0.67	51.7		-49.8	
08/28/18	1050	Pump	41.74			22.0	7.99	1408	0.63	27.4		-71.4	
08/28/18	1055	Pump	42.90			21.6	7.94	1404	0.51	14.9		-96.3	
08/28/18	1100	Pump	42.29			22.8	7.91	1411	0.53	8.95		-112.2	SURGE W/ PUMP
08/28/18	1105	Pump	42.76			22.9	7.83	1367	0.49	25.1		-108.5	
08/28/18	1110	Pump	43.88			21.7	7.94	1389	0.45	33.8		-111.8	
08/28/18	1115	Pump	43.48			22.5	7.92	1416	0.48	12.9		-110.4	
08/28/18	1120	Pump	44.91			22.7	7.92	1404	0.46	9.00		-111.2	SURGE W/ PUMP
08/28/18	1125	Pump	45.21			22.2	7.92	1385	0.42	19.5		-105.2	
08/28/18	1130	Pump	45.39			22.2	8.01	1450	0.48	20.0		-113.9	
08/28/18	1135	Pump	45.74			22.1	7.95	1417	0.38	9.52		-116.4	SURGE W/ PUMP
08/28/18	1140	Pump	46.40			21.1	7.92	1400	0.37	8.29		-117.3	
08/28/18	1145	Pump	46.43			22.2	8.03	1448	0.44	19.0		-123.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW37
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
08/28/18	1150	Pump	46.52			21.9	7.88	1405	0.33	9.48		-118.7	
08/28/18	1155	Pump	46.50			22.2	7.88	1411	0.32	5.59		-119.7	SURGE W/ PUMP
08/28/18	1200	Pump	46.20			22.3	7.89	1406	0.33	6.96		-122.1	
08/28/18	1205	Pump	46.11			22.0	7.89	1402	0.33	14.6		-122.1	
08/28/18	1210	Pump	46.30			22.0	7.87	1378	0.27	6.77		-120.7	
08/28/18	1215	Pump	46.42			22.1	7.90	1403	0.25	3.61		-122.4	
08/28/18	1220	Pump	46.28			22.2	7.86	1409	0.25	2.03		-124.2	
08/28/18	1225	Pump	46.31			22.0	7.85	1405	0.23	1.13		-124.6	
08/28/18	1230	Pump	46.35			22.0	7.86	1409	0.22	0.98		-126.8	
08/28/18	1235	Pump	46.34	91.0		22.0	7.83	1407	0.21	1.01		-125.8	1 2/3 DRUMS
~~08/28/18~~													

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW38	Date: 08/28/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 100797916	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M3667		Water Level Indicator Type/ID #: GEOTECH #6018
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKET
WELL INFO	Casing I.D. (in) [a]: 47WW38	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 23.22' BTOC
	Total Well Depth (ft) [d]: 58.36' BTOC	Water Column Thickness (ft) [d-c]: 35.14'	Well Volume (gal) ([d-c] x b):
	Ground Condition of Well: SOFT		Remarks:

CASING INFO											
	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/28/18	1400	Pump	27.98	2.25	0.45	18.9	9.14	1149	0.28	>1100		63.1	DARK, THICK SEDIMENT
08/28/18	1405	Pump	25.54	4.50	0.45	19.1	7.57	1012	0.17	>1100		-77.0	SURGE W/ PUMP
08/28/18	1410	Pump	25.91	6.75	0.45	19.1	7.32	964	0.17	>1100		-64.0	SURGE W/ PUMP
08/28/18	1415	Pump	25.72	9.00	0.45	19.2	7.40	974	0.12	>1100		-71.5	SURGE W/ PUMP
08/28/18	1420	Pump	26.75	11.25	0.45	19.0	7.33	972	0.10	>1100		-79.6	SURGE W/ PUMP
08/28/18	1425	Pump	26.68	13.5	0.45	18.9	7.14	824	0.09	>1100		-74.4	
08/28/18	1430	Pump	26.58	15.75	0.45	18.9	7.09	835	0.09	>1100		-61.6	SURGE W/ PUMP
08/28/18	1435	Pump	27.98	18.0	0.45	18.9	7.00	969	0.09	11.2		-54.4	
08/28/18	1440	Pump	28.13	~~20.9~~	~~0.45~~	18.9	7.03	881	0.08	19.4		-53.0	SURGE W/ PUMP
08/28/18	1445	Pump	27.99		0.9	18.9	7.00	925	0.08	18.1		-50.9	
08/28/18	1450	Pump	27.96		↓	19.0	7.04	894	0.07	10.3		-47.6	
08/28/18	1455	Pump	27.87		↓	19.0	7.05	917	0.09	9.4		-47.4	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW38
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/28/18	1500	Pump	~~Pump~~	36.0	0.9	19.0	7.03	931	0.19	0.18		-37.7	SURGE w/ Pump
08/28/18	1505	Pump	27.14			19.0	7.03	926	0.15	40.43		-39.4	
08/28/18	1510	Pump	26.64			19.0	7.03	887	0.10	30.07		-41.3	
08/28/18	1515	Pump	28.69			18.9	7.02	947	0.13	5.67		-42.0	
08/28/18	1520	Pump	28.78			18.9	6.99	926	0.08	0.02		-41.9	
08/28/18	1525	Pump	26.95			19.0	7.00	923	0.07	0.02		-43.4	
08/28/18	1530	Pump	26.72			19.0	6.97	898	0.07	0.02		-42.9	
08/28/18	1535	Pump	26.76			19.0	6.97	897	0.07	0.02		-42.8	
08/28/18	1540	Pump				19.0	6.97	900	0.07	0.02		-43.2	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: NEW WELL 1	Date: 6/25/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 100797916	Recorded By: ATR Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: YSI ProPlus 4076		Water Level Indicator Type/ID #: Solinst model 101
	Equipment Group:		Equipment Group:
	Development Equipment: Mono Pump		Equipment Decon.: Bucket / Brush
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 20.60 BGS
	Total Well Depth (ft) [d]: 39.60 BGS	Water Column Thickness (ft) [d-c]: 19	Well Volume (gal) ([d-c] x b):
	Ground Condition of Well:		Remarks: One WELL VOLUME 43 gallons per SOP

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date 2018	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L) %	Turb. (NTU)	Sed. (mL/L)	Radiation ORP	Remarks (odor, clarity, etc.)
6/25	1015	Pump	25.6	1	0.4	22.1	6.94	1586	41.5	15.0	—	—	Orange
1100	1105	Pump	24.60	2	0.4	21.4	6.58	1395	8.3	12.7	—	—	Brown
	1110	"	29.80	2	0.4	21.9	6.58	1237	11.5	12.7	—	—	Brown / stop 3mn for pump
1125	1130	"	29.20	2	0.4	21.1	6.83	1163	1.69	21.1	—	53.6	MILKY Brown
	1135	"	30.35	2	0.4	21.1	6.64	998	0.66	26.0	—	63.5	" "
1140	1218	"	28.10	2	0.4	21.2	6.65	1264	0.72	42.0	—	65.2	" "
	1223	"	30.7	2	0.4	20.8	6.49	1219	0.59	95.1	—	64.9	" "
	1227/1232	"	31.8	2	0.4	20.7	6.52	1186	0.59	213	—	64.9	" "
	1237	"	32.4	2	0.4	20.4	6.49	1146	0.62	—	—	65.8	" "
	1245/1250	"	30.85	2	0.4	21.2	6.46	1408	2.07	742	—	71.2	" "
	1255	"	32.65	2	0.4	21.0	6.45	1192	1.23	525	—	70.6	" "
	1258/1303	"	32.30	2	0.4	21.2	6.50	1071	0.66	71.00	—	67.3	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: NEW WELL 1
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date 2018	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) ORP	Remarks (odor, clarity, etc.)
6/25	1308	Pump	33.45	2.0	0.4	21.8	6.53	1136	1.38	267		68.9	Light Brown
6/25	1314 1319	"	33.31	2.0	0.4	21.1	6.46	1047	0.38	>1100		70.6	" "
6/25	1324	"	33.91	2.0	0.4	20.9	6.52	1042	0.59	>1100		71.8	" "
6/25	1327 1332	"	33.55	2.0	0.4	20.9	6.57	1055	0.33	>1100		66.5	" "
6/25	1337	"	34.40	2.0	0.4	20.4	6.41	1041	0.23	>1100		71.5	
6/25	1340 1345	"	32.90	2.0	0.4	20.7	6.63	1054	0.30	>1100		55.4	" "
25	1350	"	33.80	2.0	0.4	20.4	6.37	1033	0.30	>1100		66.3	
25	1355 1355	"	32.70	2.0	0.4	22.6	6.73	1072	0.69	>1100		38.6	
25	1403	"	33.60	2.0	0.4	20.4	6.39	1006	0.27	>1100		60.4	
25 1434	1434 1439	"	27.85	2.0	0.4	21.6	6.46	1084	2.45	>1100		53.4	Brown
25	1444	"	29.67	2.0	0.4	21.4	6.47	1074	2.20	>1100		55.1	
25 1448	1453	"	30.55	2.0	0.4	21.5	6.47	1045	1.68	617		57.2	
25	1458	"	31.57	2.0	0.4	21.4	6.46	1036	1.43	776		58.3	Brown
25 1501	1506	"	31.19	2.0	0.4	20.9	6.47	1016	0.92	>1100		56.7	
25	1511	"	31.08	2.0	0.4	21.0	6.46	1007	0.72	>1100		61.2	Lt Brown
25 1518	1523	"	31.02	2.0	0.4	20.2	6.36	991	0.68	>1100		68.6	" "
25	1528	"	31.95	2.0	0.4	20.4	6.37	989	0.57	>1100		68.8	
25 1532	1537	"	31.05	2.0	0.4	20.3	6.42	980	0.41	588		69.5	LT Brown
25	1542	"	31.90	2.0	0.4	20.4	6.40	982	0.41	>1100		71.2	LT Brown
25 1546	1551	"	31.30	2.0	0.4	20.3	6.48	981	0.40	>1100		69.4	LT Brown

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

40 gallons

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: NEW WELL
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date 2018	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ORP	Remarks (odor, clarity, etc.)
6/25	1556	Pump	31.89	2.4	0.4	20.4	6.46	966	0.31	595		68.7	Cloudy.
6/26	0800	Bailer	23.42	13.0									USED 1.3 Liter Bailer
6/26	0811	Pump	31.40	2.0	0.4	19.8	6.40	1005	1.73	936		259.9	30.00
6/26	0816	Pump	32.40	2.0	0.4	20.0	6.41	1007	0.67	716		252.5	Cloudy
6/26	0825	Pump	31.20	2.0	0.4	20.1	6.50	1000	0.56	518		209.5	Cloudy
6/26	0830	Pump	32.05	2.0	0.4	20.0	6.45	999	0.51	489		202.1	Cloudy
6/26	0913	Pump	28.20	2.0	0.4	20.5	6.41	1026	2.24	>1100		174.8	w/STAR 25.62
6/26	0919	Pump	29.91	2.0	0.4	20.5	6.42	1011	1.50	>1100		163.5	cloudy
"	0926	Pump	30.50	2.0	0.4	20.4	6.44	1002	1.22	870		157.5	cloudy
6/26	0931	Pump	31.55	2.0	0.4	20.6	6.44	999	1.11	848		152.5	
6/26	0940		31.00	2.0	0.4	20.5	6.49	992	0.81	671		147.2	
6/26	0945		31.70	2.0	0.4	20.3	6.43	992	1.20	469		146.4	Cloudy
6/26	0955		31.11	2.0	0.4	20.4	6.49	993	0.55	342		142.6	Cloudy
6/26	1000		31.84	2.0	0.4	20.3	6.46	990	0.58	282		142.4	1/2 vol / sheen
6/26	1010		31.33	2.0	0.4	20.3	6.50	1014	0.39	750		137.5	
6/26	1015		31.90	2.0	0.4	20.3	6.48	990	0.37	145		137.8	
6/26	1025		31.20	2.0	0.4	20.3	6.51	988	0.30	112		134.3	Slightly cloudy 1/2
6/26	1030		31.70	2.0	0.4	20.3	6.48	982	0.25	76.5		135.2	"
6/26	1040		30.80	2.0	0.4	20.3	6.50	988	0.29	69.0		132.8	" 1/2 vol
6/26	1050		30.95	2.0	0.4	20.3	6.52	985	0.41	84.5		130.5	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

63 129=3vol

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: NEW WELL 1
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) CKP	Remarks (odor, clarity, etc.)	
6/26	1055	Pump	31.25	2.0	0.4	20.4	6.49	978	0.22	53.5		132.0		116
6/26	1100	Pump	30.70	2.0	0.4	20.2	6.52	985	0.19	46.4		130.3		118
6/26	1110	Pump	30.45	2.0	0.4	20.2	6.51	981	0.14	33.9		130.1	Clear	120
6/26	1115	Pump	31.15	2.0	0.4	20.3	6.49	979	0.17	33.1		131.2	Clear	122
6/26	1123	Pump	31.00	2.0	0.4	20.3	6.51	985	0.22	28.3		130.2		124
6/26	1128	Pump	31.10	2.0	0.4	20.3	6.49	982	0.20	28.4		131.2	clear	126
6/26	1137	Pump	31.15	2.0	0.4	20.2	6.55	986	0.18	22.1		127.9	Clear	128
6/26	1142	"	31.35	2.0	0.4	20.2	6.49	981	0.14	20.6		130.1	clear	130
6/26	1147	"	31.60	2.0	0.4	20.3	6.52	983	0.17	23.3		128.5		132
6/26	1152	"	31.35	2.0	0.4	20.3	6.53	985	0.18	17.6		127.4	Clear	134
6/26	1157	"	31.15	2.0	0.4	20.3	6.54	984	0.18	19.8		127.0		136
6/26	1200	"	31.25	2.0	0.4	20.3	6.53	986	0.18	23.0		126.5		138
6/26	1203		31.89	2.0	0.4	20.3	6.54	985	0.19	22.0		126.0		140
6/26	1206	"	31.90	2.0	0.4	20.4	6.54	986	0.18	23.0	✓	126.0		142

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

129 > 3 vols

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW140	Date: 08/22/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 1009 7916	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M3667		Water Level Indicator Type/ID #: GEOTECH #6018
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKET
WELL INFO	Casing I.D. (in) [a]: 47WW40	Unit Casing Volume (gal/lin ft) [b]: 0.56	Initial Depth to Water (ft) [c]: 23.53' BTOC
	Total Well Depth (ft) [d]: 42.39' BTOC	Water Column Thickness (ft) [d-c]: 18.86'	Well Volume (gal) ([d-c] x b): 23.3 GAL
	Ground Condition of Well:		Remarks:

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
~~1635~~													JM
08/22/18	1635	Pump	24.76	2.00	0.40	22.0	7.68	122.6	8.28	380		160.7	
08/22/18	1640	Pump	25.15	4.00	0.40	22.2	7.63	132.8	7.63	251		142.9	SURGE W/ PUMP
08/22/18	1645	Pump	25.11	6.00	0.40	22.3	7.53	144.6	7.35	346		126.8	
08/22/18	1650	Pump	25.06	8.00	0.40	22.8	7.22	206.3	7.00	129		125.7	SURGE W/ PUMP
08/22/18	1655	Pump	25.04	10.00	0.40	22.4	7.01	329.2	6.51	637		130.4	
08/22/18	1700	Pump	25.16	12.00	0.40	21.5	6.65	777	4.43	202		135.7	SURGE W/ PUMP
08/22/18	1705	Pump	25.64	14.00	0.40	21.5	6.75	690	5.16	297		127.4	
08/22/18	1710	Pump	26.16	16.00	0.40	21.3	6.66	982	3.19	102		112.6	
08/23/18	0745	Pump	23.60	18.00	0.40	20.2	6.91	1115	2.97	40.8		169.3	
08/23/18	0750	Pump	26.00	20.00	0.40	20.2	6.74	1153	2.53	66.7		166.7	SURGE W/ PUMP
08/23/18	0755	Pump	25.65	22.00	0.40	20.4	6.67	1190	1.87	353		159.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW40	Date: 08/23/18
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: JM Checked By:

EQUIPMENT	Water Quality Meter Type/ID #:	Water Level Indicator Type/ID #:
	Equipment Group:	Equpment Group:
	Development Equipment:	Equipment Decon.:

WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) {[d-c] x b}:
	Ground Condition of Well:	Remarks:	

CASING INFO	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/23/18	0800	Pump	25.55	24.00	0.40	20.4	6.68	1093	2.66	197		144.1	1 WELL VOLUME
08/23/18	0805	Pump	25.55	26.00	0.40	20.4	6.64	1171	2.16	151		134.5	STOP PUMP TO BAIL
08/23/18	0810	Bail											
08/23/18	0815	Bail	24.91										CONTINUE PUMPING
08/23/18	0820	Pump	25.69	28.00	0.40	20.3	6.73	1174	2.71	61.8		137.2	MOVE PUMP TO MID-SCREEN
08/23/18	0825	Pump	26.00	30.00	0.40	20.3	6.64	1169	2.23	76.5		120.8	
08/23/18	0830	Pump	26.00	32.00	0.40	20.4	6.62	1212	1.90	60.1		107.1	
08/23/18	0835	Pump	26.00	34.00	0.40	20.4	6.61	1248	1.66	54.6		97.5	
08/23/18	0840	Pump	25.85	36.00	0.40	20.5	6.61	1269	1.44	45.1		84.8	
08/23/18	0845	Pump	25.75	38.00	0.40	20.5	6.60	1286	1.25	34.5		78.7	
08/23/18	0850	Pump	25.45	40.00	0.40	20.7	6.61	1312	0.92	33.8		72.6	MOVE PUMP TO BOTTOM
08/23/18	0855	Pump	25.35	42.00	0.40	20.6	6.61	1214	0.26			64.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW40	Date: 08/23/18
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: JM Checked By:

EQUIPMENT	Water Quality Meter Type/ID #:	Water Level Indicator Type/ID #:
	Equipment Group:	Equpment Group:
	Development Equipment:	Equipment Decon.:

WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) {[d-c] x b}:
	Ground Condition of Well:	Remarks:	

CASING INFO	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/23/18	0900	Pump	25.33	44.0	0.40	20.6	6.60	1232	0.38	55.1		60.0	
08/23/18	0905	Pump	25.33	46.0	0.40	20.6	6.60	1295	0.55	19.7		55.8	
08/23/18	0910	Pump	25.33	48.0	0.40	20.7	6.59	1324	0.64	14.4		54.5	STOP PUMP TO BAIL 2 WELL VOLUMES
08/23/18	0915	BAIL											
08/23/18	0920	BAIL	25.10										RESUME PUMPING
08/23/18	0925	Pump	25.70	50.0	0.40	20.5	6.59	1346	0.75	44.6		78.7	
08/23/18	0930	Pump	25.41	52.0	0.40	20.7	6.58	1386	0.80	35.8		65.9	
08/23/18	0935	Pump	26.61	54.0	0.40	20.6	6.58	1441	0.73	45.3		57.6	SURGE W/ PUMP
08/23/18	0940	Pump	25.55	56.0	0.40	21.0	6.58	1430	1.45	46.9		55.7	
08/23/18	0945	Pump	25.85	58.0	0.40	20.7	6.58	1433	1.29	55.8		56.2	
08/23/18	0950	Pump	25.95	60.0	0.40	20.6	6.60	1341	0.62	133		50.0	
~~08/23/18~~	~~0900~~ 0955	~~Pump~~ PUMP	25.70	62.0	0.40	20.7	6.59	1363	0.66	33.6		47.6	

Development Criteria: ~~1000~~ 1) Sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW40	Date: 08/23/18
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: JM Checked By:

EQUIPMENT	Water Quality Meter Type/ID #:	Water Level Indicator Type/ID #:
	Equipment Group:	Equipment Group:
	Development Equipment:	Equipment Decon.:

WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) {[d-c] x b}:
	Ground Condition of Well:	Remarks:	

CASING INFO	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/23/18	1000	Pump	25.55	64.0	0.40	20.7	6.59	1380	0.61	15.3		45.6	
08/23/18	1005	Pump	25.40	66.0	0.40	20.8	6.58	1430	0.68	8.02		44.1	SURGE W/ PUMP
08/23/18	1010	Pump	25.16	68.0	0.40	21.1	6.56	1523	0.81	685		34.7	
08/23/18	1015	Pump	24.87	70.0	0.40	21.2	6.60	1410	0.68	1030		34.2	MOVE PUMP TO BOTTOM
08/23/18	1020	Pump	25.01	72.0	0.40	20.9	6.60	1352	0.52	520		35.5	3 WELL VOLUMES
08/23/18	1025	Pump	25.45	74.0	0.40	20.7	6.60	1362	0.62	299		32.9	
08/23/18	1030	Pump	25.90	76.0	0.40	20.7	6.57	1512	0.54	79.3		30.0	STOP PUMP TO BAIL
08/23/18	1035	Bail											
08/23/18	1040	Bail	25.00										CONTINUE PUMPING
08/23/18	1045	Pump	25.50	78.00	0.40	20.9	6.57	1541	0.82	285		58.0	
08/23/18	1050	Pump	25.65	80.00	0.40	20.8	6.58	1471	0.64	92.8		36.7	
08/23/18	1055	Pump	25.74	82.00	0.40	20.7	6.57	1495	0.64	105		33.4	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW40	Date: 08/23/18
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: JM Checked By:

EQUIPMENT	Water Quality Meter Type/ID #:	Water Level Indicator Type/ID #:
	Equipment Group:	Equipment Group:
	Development Equipment:	Equipment Decon.:

WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) ([d-c] x b):
	Ground Condition of Well:	Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/23/18	1100	Pump	25.75	84.00	0.40	20.7	6.57	1453	0.58	110		32.3	
08/23/18	1105	Pump	25.75	86.00	0.40	20.7	6.58	1471	0.58	87.3		32.5	
08/23/18	1110	Pump	25.69	88.50	0.50	20.6	6.58	1479	0.53	72.1		30.9	SPEED UP PUMP RATE
08/23/18	1115	Pump	25.70	91.00	0.50	20.6	6.57	1518	0.51	28.8		29.0	
08/23/18	1120	Pump	25.75	93.50	0.50	20.7	6.58	1482	0.43	30.6		24.1	
08/23/18	1125	Pump	25.71	96.00	0.50	20.7	6.57	1531	0.43	24.7		20.6	
08/23/18	1130	Pump	25.75	101.50	0.50	20.6	6.58	1522	0.38	20.6		19.8	
08/23/18	1135	Pump	25.74	104.00	0.50	20.6	6.57	1535	0.37	20.3		18.3	
08/23/18	1140	Pump	25.74	106.50	0.50	20.6	6.57	1537	0.36	15.4		16.9	SURGE W/ PUMP
08/23/18	1145	Pump	25.75	109.00	0.50	20.8	6.60	1473	0.34	410		19.2	
08/23/18	1150	Pump	25.80	111.50	0.50	20.7	6.59	1500	0.30	68.6		21.4	
08/23/18	1155	Pump	25.81	114.00	0.50	20.8	6.57	1546	0.29	39.2		21.0	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW40	Date: 08/23/18
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: JM Checked By:

EQUIPMENT	Water Quality Meter Type/ID #:	Water Level Indicator Type/ID #:
	Equipment Group:	Equpment Group:
	Development Equipment:	Equipment Decon.:

WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) {[d-c] x b}:
	Ground Condition of Well:	Remarks:	

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/23/18	1200	Pump	25.79	116.50	0.50	20.8	6.57	1566	0.27	99.2		20.7	
08/23/18	1205	Pump	25.80	119.00	0.50	20.7	6.57	1549	0.27	102		20.5	
08/23/18	1210	Pump	25.85	121.50	0.50	20.8	6.57	1593	0.30	39.4		21.7	
08/23/18	1215	Pump	25.85	124.00	0.50	20.7	6.57	1583	0.31	15.8		20.4	SURGE W/ PUMP
08/23/18	1220	Pump	25.89	126.50	0.50	20.7	6.57	1666	0.40	193		21.2	
08/23/18	1225	Pump	25.81	129.00	0.50	20.6	6.58	1589	0.30	100		20.2	
08/23/18	1230	Pump	25.80	131.50	0.50	20.6	6.58	1573	0.26	39.4		20.2	
08/23/18	1235	Pump	25.80	134.00	0.50	20.5	6.58	1571	0.22	11.7		23.6	SURGE W/ PUMP
08/23/18	1240	Pump	26.00	136.50	0.50	20.6	6.55	1694	0.43	81.7		31.6	
08/23/18	1245	Pump	25.90	139.00	0.50	20.5	6.57	1651	0.27	157		33.3	
08/23/18	1250	Pump	25.90	141.50	0.50	20.5	6.58	1581	0.21	49.7		34.6	
08/23/18	1255	Pump	25.90	144.0	0.50	20.6	6.56	1603	0.24	18.4		36.3	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW40	Date: 08/23/18
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: JM Checked By:
EQUIPMENT	Water Quality Meter Type/ID #:		Water Level Indicator Type/ID #:
	Equipment Group:		Equpment Group:
	Development Equipment:		Equipment Decon.:
WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) {[d-c] x b}:
	Ground Condition of Well:	Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/23/18	1300	Pump	27.05	146.5	0.50	20.3	6.56	1635	0.31	16.8		40.1	
	1305	Pump	27.55	149.0	0.50	20.2	6.58	1613	0.31	74.8		39.9	
	1310	Pump	25.55	151.5	0.50	20.9	6.61	1449	0.13	101.1		39.8	STOP PUMPING TO GET ANOTHER BARREL
	1325	Pump	24.50	154.0	0.50	20.7	6.59	1517	0.18	31.0		71.7	
	1330	Pump	25.00	156.5	0.50	20.7	6.60	1517	0.14	22.2		64.0	SURGE W/ PUMP
	1335	Pump	24.96	159.0	0.50	20.9	6.62	1436	0.21	808		60.8	
	1340	Pump	24.90	161.5	0.50	20.7	6.58	1515	0.25	702		59.3	
	1345	Pump	24.65	164.0	0.50	20.8	6.63	1424	0.20	385		57.2	
	1350	Pump	24.61	166.5	0.50	20.9	6.62	1427	0.20	235		55.7	
	1355	Pump	24.86	169.0	0.50	20.7	6.60	1525	0.25	215		54.8	SURGE W/ PUMP
	1400	Pump	25.15	171.5	0.50	20.7	6.59	1601	0.27	272		55.8	
	1405	Pump	25.00	174.5	0.50	20.7	6.61	1483	0.20	130		54.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW40	Date: 08/23/18
	Project Name: Longhorn Army Ammunition Plant	Project #:	Recorded By: JM Checked By:
EQUIPMENT	Water Quality Meter Type/ID #:		Water Level Indicator Type/ID #:
	Equipment Group:		Equipment Group:
	Development Equipment:		Equipment Decon.:
WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) {[d-c] x b}:
	Ground Condition of Well:	Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/23/18	1410	Pump	~~24.98~~	177	0.50	20.7	6.59	1561	0.19	76.4		54.2	
08/23/18	1415	Pump	24.60	179.5	0.50	20.6	6.59	1587	0.18	47.6		53.5	SURGE W/ PUMP
	1420	Pump	24.90	182	0.50	20.7	6.53	1856	0.33	88.6		56.8	
	1425	Pump	24.95	184.5	0.50	20.9	6.56	1807	0.27	58.9		55.6	
	1430	Pump	24.90	187	0.50	20.8	6.57	1685	0.20	36.1		55.1	
	1435	Pump	24.90	189.5	0.50	21.0	6.58	1698	0.18	15.7		55.1	
	1440	Pump	25.00	192	0.50	20.7	6.58	1660	0.19	13.3		55.3	
	1445	Pump	25.00	194.5	0.50	20.9	6.58	1600	0.16	6.02		55.7	
	1450	Pump	25.00	196.5	0.50	20.7	6.58	1601	0.15	3.39		56.6	
	1455	Pump	24.98	199	0.50	20.8	6.58	1650	0.16	2.25		56.8	3 2/3 DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW41	Date: 08/21/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M3667		Water Level Indicator Type/ID #: GEOTECH #6018
	Equipment Group:		Equpment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKET
WELL INFO	Casing I.D. (in) [a]: 47WW41	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: ~~27.91' BTOC~~ 27.91' BTOC
	Total Well Depth (ft) [d]: ~~42.20' BTOC~~ JM 40.10'	Water Column Thickness (ft) [d-c]: ~~15.10'~~ 12.20'	Well Volume (gal) [(d-c] x b]: 18.915
	Ground Condition of Well: SOFT		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/21/18	1610	Pump	30.06	1.15	0.23	20.1	7.09	2702	0.37	>1100		120.3	
08/21/18	1615	Pump	30.70	2.30	0.23	20.8	6.98	3680	0.25	>1100		107.5	
08/21/18	1620	Pump	30.60	3.45	0.23	20.5	7.00	3629	0.41	>1100		99.5	
08/21/18	1625	Pump	30.61	4.60	0.23	20.8	7.03	3605	0.63	649		89.8	SURGE W/ PUMP
08/21/18	1630	Pump	30.70	5.75	0.23	20.4	7.14	3521	1.14	>1100		88.6	
08/21/18	1635	Pump	30.65	6.90	0.23	20.4	7.11	3376	0.79	>1100		87.5	
08/21/18	1640	Pump	31.05	8.05	0.23	20.3	7.09	3563	0.74	>1100		86.9	SURGE W/ PUMP
08/21/18	1645	Pump	31.50	9.20	0.23	20.3	7.08	3592	0.64	>1100		85.9	MOVE FROM BOTTOM TO MID-SCREEN
08/21/18	1650	Pump	31.90	10.35	0.23	20.5	7.10	3546	1.05	>1100		85.5	
08/21/18	1655	Pump	32.21	11.50	0.23	20.4	7.09	3574	1.01	>1100		85.5	
08/21/18	1700	Pump	32.29	12.65	0.23	20.3	7.10	3564	1.02	>1100		85.3	
08/21/18	1705	Pump	32.48	13.80	0.23	20.6	7.09	3572	1.00	>1100		85.4	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW41
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/22/18	0810	Pump	27.91			19.9	6.94	3862	0.80	>1100		163.6	STOP PUMP TO BAIL
08/22/18	0815	BAIL											
08/22/18	0820	BAIL											
08/22/18	0825	BAIL	29.19										RESUME PUMPING
08/22/18	0830	Pump	30.14	~~0.875~~	0.175	20.3	6.95	3606	1.47	>1100		140.7	SURGE W/ PUMP
08/22/18	0835	Pump	30.35	~~15.54~~	0.175	20.4	6.96	3601	1.87	>1100		135.8	MOVE TO MID SCREEN
08/22/18	0840	Pump	30.31	16.42	0.175	20.3	6.95	3600	1.92	>1100		130.2	
08/22/18	0845	Pump	30.44	17.30	0.175	20.3	6.96	3597	2.14	>1100		128.0	
08/22/18	0850	Pump	30.45	18.18	0.175	20.3	6.96	3596	2.15	>1100		126.8	
08/22/18	0855	Pump	30.44	19.06	0.175	20.3	6.96	3587	2.42	>1100		125.5	
08/22/18	0900	Pump	30.44	19.94	0.175	20.4	6.97	3569	2.92	786		124.8	SURGE W/ PUMP
08/22/18	0905	Pump	30.47	20.82	0.175	20.6	6.96	3568	2.70	>1100		124.3	
08/22/18	0910	Pump	30.65	21.70	0.175	20.3	6.97	3541	3.48	678		123.4	MOVE PUMP TO MID SCREEN
08/22/18	0915	Pump	30.68	22.58	0.175	20.8	6.99	3543	3.34	605		123.4	
08/22/18	0920	Pump	30.71	23.46	0.175	20.4	6.97	3537	3.51	437		122.0	
08/22/18	0925	Pump	30.71	24.34	0.175	20.7	6.97	3528	3.69	315		121.5	
08/22/18	0930	Pump	30.85	25.22	0.175	20.5	6.98	3514	3.64	375		120.8	SURGE W/ PUMP
08/22/18	0935	Pump	31.30	26.10	0.175	20.3	6.96	3524	3.41	>1100		121.1	MOVE PUMP TO MID SCREEN
08/22/18	0940	Pump	31.00	26.98	0.175	20.8	6.97	3511	3.25	667		120.8	
08/22/18	0945	Pump	30.90	27.86	0.175	21.0	6.96	3520	2.92	611		120.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW41
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/22/18	0950	Pump	31.00	28.74	0.175	20.5	6.95	3516	2.99	555		120.0	
08/22/18	0955	Pump	30.90	29.62	0.175	21.0	6.95	3519	2.91	567		120.1	
08/22/18	1000	Pump	30.90	30.50	0.175	21.0	6.95	3526	2.92	677		119.7	STOP PUMP, BEGIN BAILING
08/22/18	1005	Bail											~~RESUME PUMPING~~ JM
08/22/18	1010	Bail											RESUME PUMPING
08/22/18	1015	Pump	31.00	31.50	0.200	20.4	6.97	3528	3.06	>1100		127.5	SPEED UP PUMP
08/22/18	1020	Pump	31.49	32.50	0.200	20.4	6.97	3522	3.22	>1100		126.5	
08/22/18	1025	Pump	31.35	33.50	0.200	20.9	6.97	3525	3.08	>1100		125.3	
08/22/18	1030	Pump	31.60	34.50	0.200	20.5	6.95	3534	2.92	>1100		125.1	
08/22/18	1035	Pump	32.00	35.50	0.200	20.3	6.95	3547	2.79	961		124.2	
08/22/18	1040	Pump	31.69	36.50	0.200	21.4	6.98	3537	3.01	642		122.9	
08/22/18	1045	Pump	31.60	37.50	0.200	20.9	6.96	3546	2.89	437		122.5	
08/22/18	1050	Pump	31.80	38.50	0.200	21.1	6.94	3531	2.41	702		121.2	SURGE W/ PUMP
08/22/18	1055	Pump	31.34	39.50	0.200	21.8	6.93	3534	2.25	>1100		120.6	
08/22/18	1100	Pump	31.31	40.50	0.200	21.8	6.93	3542	1.99	>1100		119.6	MOVE PUMP TO MID-SCREEN
08/22/18	1105	Pump	31.30	41.50	0.200	21.0	6.91	3547	1.90	>1100		118.5	
08/22/18	1110	Pump	31.40	42.50	0.200	21.0	6.91	3555	1.87	>1100		117.7	
08/22/18	1115	Pump	31.39	43.50	0.200	21.1	6.91	3561	1.84	779		116.4	
08/22/18	1120	Pump	31.20	44.50	0.200	21.2	6.91	3566	1.74	434		115.0	
08/22/18	1125	Pump	31.15	45.50	0.200	21.4	6.92	3566	1.77	321		114.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW41
	Project Name: Longhorn Army Ammunition Plant	Project #: 1009791G

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/22/18	1130	Pump	31.20	46.50	0.200	21.1	6.91	3560	1.71	180.0		112.1	
08/22/18	1135	Pump	31.10	47.50	0.200	21.2	6.91	3562	1.65	165		109.6	
08/22/18	1140	Pump	31.25	48.50	0.200	20.7	6.90	3575	1.38	103		109.1	STOP PUMPING TO BAIL
08/22/18	1145	BAIL											
08/22/18	1150	BAIL											
08/22/18	1215	Pump	29.85	49.50	0.200	21.0	6.96	3538	2.85	>1100		141.4	CONTINUE PUMPING
08/22/18	1220	Pump	30.29	50.50	0.200	21.2	6.92	3522	2.78	>1100		139.2	
08/22/18	1225	Pump	30.49	51.50	0.200	21.2	6.92	3517	2.66	>1100		134.3	
08/22/18	1230	Pump	30.70	52.50	0.200	21.2	6.94	3505	2.86	>1100		129.8	
08/22/18	1235	Pump	30.80	53.50	0.200	20.8	6.93	3528	2.67	>1100		128.6	
08/22/18	1240	Pump	31.31	54.50	0.200	20.9	6.93	3527	2.74	>1100		126.0	
08/22/18	1245	Pump	31.10	55.50	0.200	20.9	6.94	3525	2.82	>1100		124.5	1 DRUM H2O PUMPED
08/22/18	1250	Pump	31.18	56.50	0.200	21.0	6.94	3521	3.02	>1100		123.7	
08/22/18	1255	Pump	31.15	57.50	0.200	21.0	6.94	3523	3.19	613		123.0	
08/22/18	1300	Pump	31.51	58.50	0.200	20.4	6.94	3509	3.28	189		122.3	
08/22/18	1305	Pump	31.75	59.50	0.200	20.9	6.95	3538	2.51	115		119.6	SURGE W/ PUMP
08/22/18	1310	Pump	31.81	60.50	0.200	20.9	6.93	3477	2.86	137		117.4	
08/22/18	1315	Pump	31.85	61.50	0.200	20.9	6.93	3475	2.84	109		116.6	
08/22/18	1320	Pump	31.85	62.50	0.200	20.9	6.93	3473	2.82	103		116.2	

STOP TO CALC WELL VOLUME

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WN41
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/22/18	1325	Pump	31.80	63.50	0.200	21.0	6.92	3491	2.47	88.1		115.5	
08/22/18	1330	Pump	31.75	64.50	0.200	21.1	6.92	3504	2.21	74.4		114.4	
08/22/18	1335	Pump	31.61	65.50	0.200	21.0	6.91	3514	1.86	64.3		112.0	
08/22/18	1340	Pump	31.71	66.50	0.200	20.9	6.90	3522	1.60	50.3		110.9	
08/22/18	1345	Pump	31.66	67.50	0.200	21.3	6.89	3533	1.37	37.5		108.2	SURGE W/ PUMP
08/22/18	1350	Pump	31.48	68.50	0.200	21.4	6.89	3565	1.41	>1100		106.8	
08/22/18	1355	Pump	31.50	69.50	0.200	21.1	6.90	3540	1.50	181		107.5	
08/22/18	1400	Pump	31.55	70.50	0.200	21.1	6.91	3522	1.56	134		107.3	
08/22/18	1405	Pump	31.60	71.50	0.200	21.2	6.92	3519	1.56	119		106.8	
08/22/18	1410	Pump	31.49	72.50	0.200	21.2	6.92	3520	1.53	80.8		106.3	
08/22/18	1415	Pump	31.51	73.50	0.200	21.0	6.92	3514	1.57	71.7		105.6	
08/22/18	1420	Pump	31.80	74.50	0.200	20.5	6.92	3505	1.64	40.0		105.2	
08/22/18	1425	Pump	31.95	75.50	0.200	20.6	6.92	3504	1.65	24.1		105.1	
08/22/18	1430	Pump	31.80	76.50	0.200	21.3	6.92	3504	1.71	20.5		104.5	
08/22/18	1435	Pump	31.41	77.50	0.200	21.6	6.91	3510	1.75	20.9		103.5	
08/22/18	1440	Pump	31.55	78.50	0.200	21.0	6.91	3512	1.73	19.0		103.3	
08/22/18	1445	Pump	31.64	79.50	0.200	20.9	6.91	3511	1.65	15.6		103.1	
08/22/18	1450	Pump	31.64	80.50	0.200	21.2	6.91	3513	1.56	14.3		103.0	
08/28/18	1455	Pump	31.64	81.50	0.200	21.1	6.91	3509	1.57	11.3		102.6	
08/28/18	1500	Pump	31.65	82.50	0.200	21.0	6.91	3511	1.55	11.1		101.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW41
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/22/18	1505	Pump	31.54	83.50	0.200	21.2	6.91	3515	1.48	7.55		100.9	
08/22/18	1510	Pump	31.65	84.50	0.200	20.6	6.90	3512	1.45	6.32		100.6	
08/22/18	1515	Pump	31.81	85.50	0.200	20.7	6.91	3508	1.53	3.83		100.7	~ 1 2/3 DRUMS PUMPED

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW42	Date: 08/27/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 160979.16	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ 4M3667		Water Level Indicator Type/ID #: GEOTECH #6018
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKET
WELL INFO	Casing I.D. (in) [a]: 47WW42, 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 21.85' BTOC
	Total Well Depth (ft) [d]: 43.10' BTOC	Water Column Thickness (ft) [d-c]: 21.25'	Well Volume (gal) ([d-c] x b): 24.89
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/27/18 ~~1220~~	1220	Pump	23.99	2.0	0.40	23.6	8.47	897	0.44	>1100		146.5	THICK SEDIMENT
08/27/18	1225	Pump	23.98	4.0	0.40	21.6	7.79	900	0.39	>1100		90.2	SURGE W/ PUMP
08/27/18	1230	Pump	24.19	6.0	0.40	21.3	7.71	921	0.67	>1100		-1.8	
08/27/18	1235	Pump	24.49	8.0	0.40	21.4	7.40	980	0.82	>1100		-3.9	SURGE W/ PUMP
08/27/18	1240	Pump	24.38	10.0	0.40	21.3	7.20	1034	0.76	>1100		0.9	
08/27/18	1245	Pump	24.33	12.0	0.40	21.3	7.20	1070	0.57	542		6.1	
08/27/18	1250	Pump	24.32	14.0	0.40	21.2	7.05	1148	0.47	289		8.3	SURGE W/ PUMP
08/27/18	1255	Pump	25.05	16.0	0.40	21.0	7.04	1168	0.35	187		6.3	SURGE W/ PUMP
08/27/18	1300	Pump	24.55	18.0	0.40	21.4	7.71	1135	0.30	318		2.0	
08/27/18	1305	Pump	24.46	20.0	0.40	21.2	6.97	1206	0.26	80.8		12.4	
08/27/18	1310	Pump	24.44	22.0	0.40	21.2	6.95	1200	0.24			11.0	ONE WELL VOLUME
08/27/18	1315	BAIL											STOP PUMPING TO BAIL

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW42
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979 16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/27/18	0320	BAIL			~~0.4~~								RESUME PUMPING
08/27/18	0325	Pump	23.43	24.0	0.4	21.9	6.87	1287	0.54	533		33.1	
08/27/18	1330	Pump	23.47	26.0	0.4	21.9	6.87	1298	0.58	515		31.7	
08/27/18	1335	Pump	23.52	28.0	0.4	21.9	6.84	1352	0.55	424		27.8	
08/27/18	1340	Pump	23.30	30.0	0.4	21.6	6.85	1350	0.49	386		25.4	SURGE W/ PUMP
08/27/18	1345	Pump	23.45	32.0	0.4	21.7	6.97	1205	0.40	>1100		22.2	
08/27/18	1350	Pump	24.14	34.0	0.4	21.2	6.84	1354	0.34	259		21.0	SURGE W/ PUMP
08/27/18	1355	Pump	24.09	36.0	0.4	21.2	6.82	1332	0.27	632		17.5	
08/27/18	1400	Pump	24.39	38.0	0.4	21.0	6.80	1353	0.26	149		17.2	
08/27/18	1405	Pump	24.21	40.0	0.4	21.1	6.77	1382	0.22	53.5		16.0	SURGE W/ PUMP
08/27/18	1410	Pump	24.25	42.0	0.4	21.2	7.01	1132	0.21	132		13.3	
08/27/18	1415	Pump	24.23	44.0	0.4	20.9	6.89	1182	0.19	66.8		21.2	
08/27/18	1420	Pump	24.24	46.0	0.4								
08/27/18	1425	Pump	24.30	48.0	0.4	21.2	6.76	1362	0.17	29.8		17.5	STOP PUMP TO BAIL
08/27/18	~~1430~~	BAIL	~~?~~										2 WELL VOLUMES
08/27/18	1440	BAIL	23.96										CONTINUE PUMPING
08/27/18	1445	Pump	23.94	50.0	0.4	21.4	6.68	1554	0.49	173		34.1	
08/27/18	1450	Pump	24.12	52.0	0.4	21.1	6.76	1433	0.37	145		26.7	
08/27/18	1455	Pump	24.14	54.0	0.4	21.1	6.73	1426	0.25	63.6		26.0	SURGE W/ PUMP
08/27/18	1500	Pump	24.28	56.0	0.4	21.0	6.72	1459	0.23	131		22.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW42
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/27/18	1505	Pump	23.69	58.0	0.4	21.1	6.73	1441	0.21	49.8		24.1	SURGE W/ PUMP
08/27/18	1510	Pump	23.64	60.0	0.4	21.1	6.78	1313	0.17	175		24.1	
08/27/18	1515	Pump	23.64	62.0	0.4	21.1	6.73	1426	0.18	53.9		25.7	
08/27/18	1520	Pump	23.62	64.0	0.4	21.0	6.73	1418	0.17	37.4		25.9	
08/27/18	1525	Pump	23.60	66.0	0.4	21.1	6.73	1419	0.15	30.9		25.6	SURGE W/ PUMP
08/27/18	1530	Pump	23.52	68.0	0.4	21.1	6.78	1296	0.15	104		25.1	
08/27/18	1535	Pump	23.56	70.0	0.4	21.0	6.73	1404	0.14	34.6		24.6	
08/27/18	1540	Pump	23.59	72.0	0.4	21.0	6.73	1407	0.13	24.0		23.9	
08/27/18	1545	Pump	23.62	74.0	0.4	21.0	6.73	1413	0.13	20.8		23.6	STOP PUMP TO BAIL
08/27/18	1550	BAIL	±										3 WELL VOLUMES
08/27/18	1600	BAIL	23.82										RESUME PUMPING
08/27/18	1605	Pump	23.71	76.0	0.4	21.5	6.72	1430	0.31	116		49.4	
08/27/18	1610	Pump	23.67	78.0	0.4	21.1	6.74	1417	0.27	82.7		34.8	
08/27/18	1615	Pump	23.80	80.0	0.4	21.0	6.73	1399	0.23	30.9		32.4	
08/27/18	1620	Pump	23.75	82.0	0.4	21.0	6.72	1389	0.17	12.3		30.5	
08/27/18	1625	Pump	23.78	84.0	0.4	21.0	6.72	1384	0.16	8.09		29.7	SURGE W/ PUMP
08/27/18	1630	Pump	23.79	86.0	0.4	21.0	6.75	1095	0.16	32.3		30.4	
08/27/18	1635	Pump		88.0	0.4	21.2	6.82	1185	0.16	33.2		34.4	
08/27/18	1640	Pump		90.0	0.4	21.2	6.80	1218	0.16	23.9		34.8	
08/27/18	1645	Pump		92.0	0.4	21.2	6.76	1269	0.14	14.8		33.8	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW42
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/27/18	1650	Pump		94.0	0.4	21.1	6.75	1283	0.12	8.29		32.5	STOP PUMPING FOR DAY
08/28/18	0750	Pump	23.32	96.0	0.4	20.7	6.97	1242	0.54	6.39		137.5	RESUME PUMPING
08/28/18	0755	Pump	23.05	98.0	0.4	21.0	6.80	1361	0.28	5.67		118.5	
08/28/18	0800	Pump	22.66	100.0	0.4	21.3	6.75	1427	0.23	5.59		102.9	SURGE W/ PUMP
08/28/18	0805	Pump	23.09	102.0	0.4	21.3	6.68	1587	0.21	96.2		48.5	
08/28/18	0810	Pump	23.09	104.0	0.4	21.1	6.81	1347	0.23	57.5		26.2	
08/28/18	0815	Pump	23.15	106.0	0.4	21.1	6.86	1267	0.22	38.1		23.1	
08/28/18	0820	Pump	23.21	108.0	0.4	21.0	6.84	1293	0.21	27.1		20.8	
08/28/18	0825	Pump	23.22	110.0	0.4	21.0	6.82	1308	0.19	17.0		12.8	SURGE W/ PUMP
08/28/18	0830	Pump	23.26	112.0	0.4	21.0	6.62	1710	0.14	26.7		8.4	
08/28/18	0835	Pump	23.32	114.0	0.4	21.0	6.78	1341	0.16	37.0		-2.6	
08/28/18	0840	Pump	23.34	116.0	0.4	21.0	6.81	1267	0.15	21.2		2.1	
08/28/18	0845	Pump	23.39	118.0	0.4	20.9	6.76	1327	0.13	14.7		5.6	
08/28/18	0850	Pump	23.41	120.0	0.4	20.9	6.76	1301	0.12	10.3		5.6	
08/28/18	0855	Pump	23.45	122.0	0.4	20.9	6.74	1322	0.11	5.18		4.9	
08/28/18	0900	Pump	23.48	124.0	0.4	20.9	6.74	1338	0.11	3.24		4.5	
08/28/18	0905	Pump	23.50	126.0	0.4	20.9	6.73	1319	0.11	2.87		4.8	2½ DRUMS

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW43	Date: 08/23/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M3667		Water Level Indicator Type/ID #: GEOTECH #6018
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKET
WELL INFO	Casing I.D. (in) [a]: 47WW43, 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 25.39' BTOC
	Total Well Depth (ft) [d]: 35.39' BTOC	Water Column Thickness (ft) [d-c]: 10.00	Well Volume (gal) ([d-c] x b): 15.65
	Ground Condition of Well: SOFT, MUDDY		Remarks:

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/24/18	0745	Pump	27.13	1.2	0.24	18.9	7.19	3412	0.24	>1100		191.8	SURGE W/ PUMP
08/24/18	0750	Pump	28.44	2.4		19.0	7.35	3722	1.24	>1100		172.4	
08/24/18	0755	Pump	28.48	3.6		19.4	7.38	3828	2.86	>1100		154.3	SURGE W/ PUMP
08/24/18	0800	Pump	28.70	4.8		19.5	7.25	3935	2.21	>1100		147.9	
08/24/18	0805	Pump	28.79	6.0		19.3	7.19	3984	2.07	>1100		142.9	SURGE W/ PUMP
08/24/18	0810	Pump	28.80	7.2		19.5	7.12	4057	1.90	>1100		136.7	
08/24/18	0815	Pump	28.84	8.4		19.5	7.10	4078	1.80	>1100		130.8	SURGE W/ PUMP
08/24/18	0820	Pump	29.09	9.6		19.1	7.06	4109	1.66	>1100		124.0	
08/24/18	0825	Pump	29.09	10.8		19.5	7.06	4135	1.60	>1100		116.7	SURGE W/ PUMP
08/24/18	0830	Pump	29.20	12.0		19.3	7.04	4133	1.53	>1100		111.4	
08/24/18	0835	Pump	29.16	13.2		19.7	7.05	4137	1.64	>1100		105.5	SURGE W/ PUMP
08/24/18	0840	Pump	29.18	14.4	↓	19.5	7.04	4148	1.55	>1100		100.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: ~~LHAAP-47~~	LocID: 47WW43
	Project Name: Longhorn Army Ammunition Plant	Project #: ~~LHAAP-47~~ JM 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/24/18	0845	Pump	29.17	15.6	↓	19.9	7.02	4163	1.54	>1100		98.6	Surge w/ Pump
08/24/18	0850	Pump	29.39	16.8	↓	19.5	7.02	4181	1.58	>1100		95.3	
08/24/18	0855	Pump	29.45	18.0	↓	19.7	7.02	4188	1.58	>1100		94.4	
08/24/18	0900	Bail		18.05	0.24								Stop Pump to Bail
08/24/18	0910	Bail	28.82										Resume Pumping
08/24/18	0915	Pump	29.68		0.20	19.4	7.02	4213	2.24	>1100		107.5	
08/24/18	0920	Pump	29.74		↓	19.6	7.02	4210	2.16	>1100		106.4	~~Sv~~
08/24/18	0925	Pump	29.80		↓	19.5	7.00	4220	2.10	>1100		105.3	Surge w/ Pump
08/24/18	0930	Pump	29.63		↓	20.6	7.01	4230	2.40	>1100		104.4	
08/24/18	0935	Pump	29.64		↓	20.1	7.00	4214	2.28	>1100		105.0	Surge w/ Pump
08/24/18	0940	Pump	29.63		↓	20.2	7.00	4238	2.12	>1100		104.8	
08/24/18	0945	Pump	29.54		↓	20.4	6.99	4245	2.03	>1100		104.6	Surge w/ Pump
08/24/18	0950	Pump	29.49		↓	20.2	7.00	4260	2.05	>1100		103.7	
08/24/18	0955	Pump	29.34		↓	20.4	6.99	4252	2.10	>1100		103.4	Surge w/ Pump
08/24/18	1000	Pump	29.44		↓	20.0	6.99	4267	2.10	>1100		103.2	
08/24/18	1005	Pump	29.53		↓	20.0	6.99	4264	2.17	>1100		103.5	Surge w/ Pump
08/24/18	1010	Pump	29.65		↓	20.0	6.99	4267	2.24	>1100		103.3	
08/24/18	1015	Pump	29.54		↓	20.3	6.99	4258	2.20	>1100		103.5	Surge w/ Pump
08/24/18	1020	Pump	29.49		↓	19.9	6.98	4278	2.15	>1100		103.1	
08/24/18	1025	Pump	29.37		↓	20.5	6.97	4272	2.03	>1100		103.3	Surge w/ Pump

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW43
	Project Name: Longhorn Army Ammunition Plant	Project #: ~~LHAAP-47~~ PM 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
08/24/18	1030	Pump	29.43		↓	20.4	6.97	4293	2.04	>1100		102.6	
08/24/18	1035	Pump	29.38		↓	20.4	6.97	4285	1.99	>1100		101.9	SURGE W/ PUMP
08/24/18	1040	Pump	29.51		↓	20.2	6.97	4286	2.07			101.1	STOP PUMP TO BAIL
08/24/18	1045	BAIL		36.0	0.20								
08/24/18	1055	BAIL	28.85										RESUME PUMPING
08/24/18	1100	Pump	29.80		0.18	20.3	6.98	4279	2.54	>1100		110.0	
08/24/18	1105	Pump	29.83		↓	20.3	6.98	4272	2.39	>1100		108.7	SURGE W/ PUMP
08/24/18	1110	Pump	29.82		↓	20.1	6.98	4280	2.40	>1100		107.5	
08/24/18	1115	Pump	29.80		↓	20.8	6.97	4284	2.26	>1100		106.7	SURGE W/ PUMP
08/24/18	1120	Pump	29.71		↓	20.8	6.97	4294	2.19	>1100		105.7	
08/24/18	1125	Pump	29.43		↓	20.8	6.97	4290	2.20	>1100		104.8	SURGE W/ PUMP
08/24/18	1130	Pump	29.51		↓	20.4	6.97	4291	2.33	>1100		104.4	
08/24/18	1135	Pump	29.63		↓	20.5	6.97	4284	2.29	>1100		104.0	SURGE W/ PUMP
08/24/18	1140	Pump	29.73		↓	20.3	6.97	4294	2.37	>1100		103.8	
08/24/18	1145	Pump	29.48		↓	21.2	6.97	4291	2.34	>1100		103.2	SURGE W/ PUMP
08/24/18	1150	Pump	29.37		↓	20.4	6.97	4301	2.26	>1100		102.8	
08/24/18	1155	Pump	29.28		↓	21.1	6.97	4295	2.28	>1100		102.2	SURGE W/ PUMP
08/24/18	1200	Pump	29.35		↓	20.0	6.97	4290	2.38	>1100		101.8	
08/24/18	1205	Pump	29.30		↓	20.5	6.96	4267	2.32	>1100		101.3	SURGE W/ PUMP
08/24/18	1210	Pump	29.26		↓	20.8	6.97	4270	2.43	>1100		101.0	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW43
	Project Name: Longhorn Army Ammunition Plant	Project #: ~~LHAAP-47~~ 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/24/18	1215	Pump	29.18	↓		20.7	6.97	4258	2.48	1080		100.5	SURGE W/ PUMP
08/24/18	1220	Pump	29.19			21.0	6.96	4283	2.35	976		100.0	
08/24/18	1225	Pump	29.19			20.5	6.94	4278	2.20	849		100.2	
08/24/18	1230	Pump	29.18	↓		19.8	6.95	4286	2.21	721		99.5	SURGE W/ PUMP
08/24/18	1235	Pump	29.29	55.0		20.9	6.97	4291	2.50	715		98.9	STOP PUMP TO BAIL
08/24/18	1240	BAIL											
08/24/18	1250	BAIL	29.20										RESUME PUMP
08/24/18	1255	Pump	29.05		0.18	23.3	6.98	4294	2.87	>1100		106.7	
08/24/18	1300	Pump	29.25		↓	21.5	6.96	4278	2.74	>1100		106.1	
08/24/18	1305	Pump	29.32			21.6	6.96	4297	2.64	>1100		102.4	SURGE W/ PUMP
08/24/18	1310	Pump	29.73			20.1	6.95	4263	2.60	>1100		101.0	
08/24/18	1315	Pump	29.50			21.7	6.97	4286	2.84	>1100		97.8	
08/24/18	1320	Pump	29.75			19.7	6.95	4270	2.64	>1100		97.0	
08/24/18	1325	Pump	29.59			22.3	6.97	4273	2.67	>1100		94.3	SURGE W/ PUMP
08/24/18	1330	Pump	28.00			20.9	6.95	4309	2.01	613		92.7	
08/24/18	1335	Pump	28.98			21.0	6.95	4313	1.98	301		89.8	
08/24/18	1340	Pump	29.70			22.7	6.95	4271	1.86	257		88.0	SURGE W/ PUMP
08/24/18	1345	Pump	29.70			21.2	6.94	4336	1.74	185		86.4	
08/24/18	1350	Pump	29.49			21.8	6.94	4337	1.66	190		82.9	
08/24/18	1355	Pump	29.52		↓	21.2	6.94	4348	1.63			78.4	SURGE W/ PUMP

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW43
	Project Name: Longhorn Army Ammunition Plant	Project #: ~~LHAAP-47~~ pm 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
08/24/18	1400	Pump	29.84		↓	21.3	6.93	4323	1.59	492		75.4	
08/24/18	1405	Pump	30.00			20.8	6.95	4286	2.01	236		76.6	
08/24/18	1410	Pump	29.65			21.8	6.95	4303	1.91	166		78.0	
08/24/18	1415	Pump	29.18			21.2	6.94	4327	1.80	89.8		78.3	
08/24/18	1420	Pump	29.70			20.3	6.93	4316	1.69	65.8		78.1	SURGE W/ PUMP
08/24/18	1425	Pump	29.70		↓	20.1	6.93	4340	1.62	139		77.6	MOVE TO MID-SCREEN
08/24/18	1430	Pump	29.85	73.0	0.18	20.8	6.96	4301	2.22	93.6		79.5	
08/24/18	1435	Pump	29.70		↓	21.5	6.96	4316	2.06	64.2		79.2	
08/24/18	1440	Pump	29.75			20.8	6.94	4325	1.92	41.8		79.4	
08/24/18	1445	Pump	29.90			21.4	6.96	4310	2.16	42.5		78.9	
08/24/18	1450	Pump	29.80			21.4	6.95	4296	2.19	20.3		78.6	
08/24/18	1455	Pump			↓	19.4	6.92	4292	1.99	86.0		80.8	SURGE W/ PUMP
08/27/18	0745	Pump	25.48		0.12	19.0	7.00	4449	1.06	108		165.8	SURGE W/ PUMP
08/27/18	0750	Pump	26.79		↓	20.9	6.92	4480	0.97	>1100		122.3	
08/27/18	0755	Pump	26.75			19.9	6.92	4408	1.52	>1100		110.2	
08/27/18	0800	Pump	26.99			20.5	6.94	4372	1.97	>1100		97.8	SURGE W/ PUMP
08/27/18	0805	Pump	27.15			19.3	6.97	4307	3.20	>1100		88.4	
08/27/18	0810	Pump	27.18			20.7	6.96	4279	3.11	>1100		90.1	
08/27/18	0815	Pump	27.29			20.8	6.96	4283	3.21	1060		88.7	
08/27/18	0820	Pump	27.46		↓	20.5	6.96	4286	3.06	819		88.4	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47GWM43
	Project Name: Longhorn Army Ammunition Plant	Project #: ~~LHAAP-47~~ PM 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/27/18	0825	Pump	27.44			21.5	6.96	4271	3.16	809		88.3	
08/27/18	0830	Pump	27.45			21.3	6.95	4321	2.83	309		85.5	SURGE W/ PUMP
08/27/18	0835	Pump	27.76			20.3	6.98	4179	4.37	331		87.2	
08/27/18	0840	Pump	27.74			21.2	6.99	4178	4.42	394		89.7	
08/27/18	0845	Pump	27.76			21.1	6.96	4239	3.83	205		89.9	
08/27/18	0850	Pump	27.77			20.4	6.95	4212	3.93	192		91.7	
08/27/18	0855	Pump	27.74			21.7	6.97	4226	3.98	108		91.8	
08/27/18	0900	Pump	27.87			20.9	6.94	4218	3.67	87.9		90.8	
08/27/18	0905	Pump	27.79			21.9	6.96	4257	3.60	78.8		86.3	
08/27/18	0910	Pump	28.50			21.3	6.95	4238	3.61	50.7		96.0	
08/27/18	0915	Pump	27.76			21.6	6.95	4245	3.07	42.0		85.5	
08/27/18	0920	Pump	27.84			21.2	6.94	4235	3.33	33.6		82.3	
08/27/18	0925	Pump	27.74			22.4	6.95	4245	3.44	28.5		81.4	
08/27/18	0930	Pump	27.80			20.8	6.93	4214	3.36	22.5		83.6	
08/27/18	0935	Pump	27.77			22.1	6.94	4278	3.34	20.5		81.6	
08/27/18	0940	Pump	27.88			21.5	6.93	4242	3.54	17.4		82.3	
08/27/18	0945	Pump	27.82		↓	21.6	6.94	4265	3.55	15.6		80.8	SURGE W/ PUMP
08/27/18	0950	Pump	27.95	91.0	0.12	20.3	6.94	4186	4.04	149		80.3	
08/27/18	0955	Pump	28.49		0.15	21.8	6.95	4187	3.92	125		86.5	
08/27/18	1000	Pump	28.22		↓	21.0	6.93	4160	3.75	114		86.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47LW43
	Project Name: Longhorn Army Ammunition Plant	Project #: ~~LHAAP-47~~ PM 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
08/27/18	1005	Pump	28.09		0.15	20.8	6.96	4214	3.89	83.8		88.3	
08/27/18	1010	Pump	28.08			22.1	6.93	4211	3.51	60.0		84.7	
08/27/18	1015	Pump	28.07			22.0	6.93	4213	3.23	40.0		84.5	
08/27/18	1020	Pump	28.05			20.7	6.92	4188	3.28	29.0		82.6	
08/27/18	1025	Pump	28.03			21.7	6.94	4264	3.38	27.4		84.1	
08/27/18	1030	Pump	28.01			20.9	6.91	4205	3.29	22.0		83.0	
08/27/18	1035	Pump	28.02			21.5	6.92	4253	3.30	14.3		82.9	
08/27/18	1040	Pump	28.00			21.6	6.92	4256	3.25	9.88		82.6	
08/27/18	1045	Pump	27.96			21.8	6.92	4256	3.16	8.07		82.0	
08/27/18	1050	Pump	28.01	100.0	↓	21.3	6.92	4258	3.26	7.23		81.6	1 3/4 DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44	Date: 08/29/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M3667		Water Level Indicator Type/ID #: GEOTECH #6018
	Equipment Group:		Equpment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKET
WELL INFO	Casing I.D. (in) [a]: 47WW44	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 25.97' BTOC
	Total Well Depth (ft) [d]: 61.78' BTOC	Water Column Thickness (ft) [d-c]: 35.81	Well Volume (gal) ([d-c] x b): 30.18
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/29/18	1035	Pump	27.20	0.56	0.11	20.1	9.17	239.5	2.68	>1100		54.9	
08/29/18	1040	Pump	28.06			20.7	9.05	203.2	2.83	>1100		67.6	SURGE W/ PUMP
08/29/18	1045	Pump	28.74			21.5	9.15	209.9	2.64	>1100		58.5	THICK W/ SEDIMENT
08/29/18	1050	Pump	29.60			21.4	8.54	265.3	1.81	>1100		69.2	
08/29/18	1055	Pump	30.81			23.0	8.17	355.4	1.83	>1100		81.8	SURGE W/ PUMP
08/29/18	1100	Pump	29.99			23.4	7.68	558	1.56	>1100		97.6	
08/29/18	1105	Pump	30.10			23.6	7.18	503.2	1.94	>1100		95.0	
08/29/18	1110	Pump	30.79			22.4	7.00	646	1.74	>1100		59.7	SURGE W/ PUMP
08/29/18	1115	Pump	32.15			21.3	6.88	594	1.95	>1100		26.3	
08/29/18	1120	Pump	32.80			22.7	6.87	860	1.90	>1100		11.0	
08/29/18	1125	Pump	33.24			23.0	6.88	851	1.87	>1100		14.6	
08/29/18	1130	Pump	33.74	↓	↓	23.3	6.87	848	1.80	>1100		16.9	SURGE W/ PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 10897916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/29/18	1135	Pump	33.95	~~0.56~~	0.11	22.5	6.74	1119	1.63	>1100		4.5	
08/29/18	1140	Pump	34.06	~~1.125~~		23.7	6.83	1010	1.61	>1100		8.6	
08/29/18	1145	Pump	34.17			24.9	6.98	918	1.59	>1100		10.5	SURGE W/ PUMP
08/29/18	1150	Pump	35.06			22.6	7.23	892	1.97	>1100		1.32	
08/29/18	1155	Pump	35.50			21.9	7.81	834	2.07	>1100		-14.8	
08/29/18	1200	Pump	35.63			24.1	7.09	1116	1.58	>1100		4.7	SURGE W/ PUMP
08/29/18	1205	Pump	35.85			20.8	6.78	1569	1.14	>1100		-16.1	
08/29/18	1210	Pump	36.42			22.9	7.45	1112	1.54	>1100		-26.7	
08/29/18	1215	Pump	36.44			26.0	7.28	1210	1.55	>1100		-7.1	SURGE W/ PUMP
08/29/18	1220	Pump	37.19			22.4	6.77	1682	1.10	>1100		-25.6	
08/29/18	1225	Pump	37.29			22.9	8.53	1114	1.66	>1100		-18.1	
08/29/18	1230	Pump	37.40			23.6	10.01	843	1.87	>1100		-9.5	
08/29/18	1235	Pump	38.03			22.8	9.04	972	1.79	1081		2.7	
08/29/18	1240	Pump	38.55			22.1	9.22	1166	1.76	988		12.4	SURGE W/ PUMP
08/29/18	1245	Pump	38.79			22.8	8.88	1285	1.60	871		14.4	
08/29/18	1250	Pump	38.67			23.7	8.21	1567	1.43	893		4.84	
08/29/18	1255	Pump	38.50			24.4	7.31	1750	1.03	906		-65.2	
08/29/18	1310	Pump	39.09			22.3	7.04	1924	0.98	792		-59.3	
08/29/18	1305	Pump	39.48	↓		21.6	6.70	2325	0.62	587		-44.6	
08/29/18	1310	Pump	39.96	18.0	0.11	22.0	6.81	2173	0.74	548		-49.7	SURGE W/ PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/29/18	1315	Pump	40.24		0.14	21.7	7.03	2050	0.83	476		-67.6	
08/29/18	1320	Pump	40.84			21.2	7.15	2009	0.96	342		-80.1	
08/29/18	1325	Pump	40.86			21.6	7.21	1983	0.96	357		-78.4	
08/29/18	1330	Pump	41.33			21.1	7.01	2165	0.87	299		-62.1	
08/29/18	1335	Pump	41.62			20.8	6.80	2351	0.64	278		-53.7	SURGE W/ PUMP
08/29/18	1340	Pump	42.10			20.5	7.22	1958	0.93	334		-72.7	
08/29/18	1345	Pump	42.16			22.4	9.91	1426	1.20	308		-50.5	MOVE PUMP TO MID-SCREEN
08/29/18	1350	Pump	42.19			24.1	10.19	1332	1.71	279		-43.1	
08/29/18	1355	Pump	42.11			25.0	8.89	1761	1.20	227		-46.1	
08/29/18	1400	Pump	42.01			25.9	8.91	1807	1.09	206		-48.8	SURGE W/ PUMP
08/29/18	1405	Pump	41.86			23.0	7.09	2256	0.71	142		-94.7	MOVE PUMP TO BOTTOM
08/29/18	1410	Pump	42.00			22.2	6.99	2341	0.63	128		-52.9	
08/29/18	1415	Pump	42.39			21.5	6.83	2506	0.54	105		-67.1	SURGE W/ PUMP
08/29/18	1420	Pump	42.59			21.3	6.78	2557	0.49	98.6		-60.3	
08/29/18	1425	Pump	42.87			21.4	6.85	2444	0.58	103		-70.9	
08/29/18	1430	Pump	43.09			21.3	6.99	2394	0.66	121		-78.6	
08/29/18	1435	Pump	43.40			21.3	6.83	2477	0.58	130		-61.2	
08/29/18	1440	Pump	43.41			22.8	7.01	2324	0.69	139		-66.4	
08/29/18	1445	Pump	43.39			23.4	6.95	2342	0.72	143		-69.0	
08/29/18	1450	Pump	43.65		↓	21.0	6.65	2719	0.40	130		-47.8	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/29/18	1455	Pump	43.73			21.3	6.80	2624	0.46	122		-50.6	
08/29/18	1500	Pump	43.85			21.6	6.72	2611	0.48	108		-52.1	
08/29/18	1505	Pump	43.86			21.5	6.70	2631	0.44	101		-50.9	
08/29/18	1510	Pump	43.89			21.4	6.67	2676	0.43	98.7		-49.2	SURGE W/ PUMP
08/29/18	1515	Pump	43.39	~~36.0~~	~~gpm~~ ↓	22.0	7.89	2049	1.01	119		-100.6	
08/29/18	1520	Pump	43.25	36.0	0.14	23.1	9.55	1810	1.18	217		-117.7	ONE WELL VOLUME
08/29/18	1525	BAIL											STOP PUMP TO BAIL
08/29/18	1530	BAIL											
08/29/18	1535	Pump	43.40			22.1	6.74	2773	0.66	92.9		-72.6	RESUME PUMPING
08/29/18	1540	Pump	43.81			21.4	6.65	2868	0.48	78.8		-56.3	
08/29/18	1545	Pump	44.48			21.5	6.72	2745	0.47	92.9		-60.6	
08/29/18	1550	Pump	44.66			21.1	6.72	2735	0.49	103		-50.9	
08/29/18	1555	Pump	44.76			21.4	6.69	2808	0.40	109		-49.4	
08/29/18	1600	Pump	44.87			21.3	6.63	2905	0.38	119		-45.6	
08/29/18	1605	Pump	45.20			21.0	6.73	2714	0.49	117		-49.2	
08/29/18	1610	Pump	45.16			21.7	6.68	2854	0.39	120.		-46.9	
08/29/18	1615	Pump	44.80			22.2	6.62	2960	0.34	101		-44.7	
08/29/18	1620	Pump	44.68			22.3	6.59	3005	0.32	94.4		-43.5	
08/29/18	1625	Pump	44.90			21.1	6.53	3130	0.23	94.0		-39.9	
08/29/18	1630	Pump	45.60			20.9	6.69	2771	0.44	90.1		-45.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979 16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/30/18	0820	Pump	26.99		~~0.29~~	19.7	6.69	3324	0.27	>1100		-37.4	
08/30/18	0825	Pump	28.56			19.0	6.56	3233	0.22	69.4		-31.3	
08/30/18	0830	Pump	28.64			20.6	6.53	3225	0.37	43.1		-31.4	SURGE w/ PUMP
08/30/18	0835	Pump	29.12			20.9	6.52	3274	0.24	222		-31.7	
08/30/18	0840	Pump	29.66			21.0	6.52	3262	0.26	209		-33.4	
08/30/18	0845	Pump	30.01			21.2	6.51	3227	0.26	150		-35.3	
08/30/18	0850	Pump	31.03			20.8	6.50	3244	0.20	87.2		-35.4	
08/30/18	0855	Pump	31.59			19.9	6.48	3268	0.18	65.8		-35.7	
08/30/18	0900	Pump	31.33			20.4	6.44	3330	0.18	32.4		-38.2	
08/30/18	0905	Pump	31.26			21.3	6.45	3353	0.17	27.2		-40.1	SURGE w/ PUMP
08/30/18	0910	Pump	31.31			22.0	6.42	3442	0.19	12.5		-40.7	
08/30/18	0915	Pump	31.38			21.9	6.44	3429	0.15	30.9		-42.7	
08/30/18	0920	Pump	31.47			21.8	6.51	3212	0.19	118		-45.1	
08/30/18	0925	Pump	31.58			21.4	6.48	3242	0.17	107		-44.6	
08/30/18	0930	Pump	31.77			20.3	6.45	3319	0.12	55.2		-38.0	
08/30/18	0935	Pump	31.98			21.3	6.43	3362	0.13	64.3		-38.9	SURGE w/ PUMP
08/30/18	0940	Pump	32.10			21.2	6.45	3347	0.14	50.6		-40.7	
08/30/18	0945	Pump	32.71			20.7	6.49	3210	0.16	117		-42.9	
08/30/18	0950	Pump	33.09			20.5	6.46	3276	0.16	86.4		-43.1	
08/30/18	0955	Pump	33.76		↓	20.5	6.46	3278	0.15	67.9		-43.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
08/30/18	1000	Pump	33.89		↓	21.1	6.49	3252	0.17	60.1		-44.6	
08/30/18	1005	Pump	34.03			21.4	6.47	3298	0.14	46.4		-44.4	
08/30/18	1010	Pump	34.21			21.3	6.46	3305	0.13	32.1		-44.7	
08/30/18	1015	Pump	34.22			21.3	6.45	3349	0.14	26.5		-44.8	
08/30/18	1020	Pump	34.24			21.2	6.45	3356	0.14	22.8		-44.8	
08/30/18	1025	Pump	34.64			22.2	6.45	3369	0.13	19.3		-45.9	
08/30/18	1030	Pump	34.86			20.5	6.43	3363	0.10	22.5		-44.7	
08/30/18	1035	Pump	35.04			21.0	6.44	3312	0.11	24.6		-45.9	
08/30/18	1040	Pump	35.20	60.0	~~0.29~~	21.7	6.46	3301	0.10	28.1		-47.0	~~P WATER~~ gm 2 WELL VOLUMES
08/30/18	1045	BAIL											STOP PUMP TO BAIL
08/30/18	1050	BAIL											
08/30/18	1055	Pump	35.85			20.7	6.71	3183	0.36	69.4		-63.1	CONTINUE PUMPING
08/30/18	1100	Pump	35.81			21.8	6.59	3078	0.51	76.2		-39.1	
08/30/18	1105	Pump	35.80			22.4	6.50	3244	0.30	43.9		-36.3	
08/30/18	1110	Pump	35.78			22.3	6.45	3386	0.22	22.4		-32.3	
08/30/18	1115	Pump	35.89			23.3	6.46	3359	0.24	24.2		-34.6	
08/30/18	1120	Pump	86.04			22.9	6.46	3360	0.22	36.8		-34.9	
08/30/18	1125	Pump	36.11			21.1	6.48	3374	0.18	53.6		-36.2	
08/30/18	1130	Pump	36.12			21.5	6.49	3341	0.21	53.8		-37.9	
08/30/18	1135	Pump	36.10			21.7	6.49	3333	0.20	55.4		-39.4	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/30/18	1140	Pump	36.01			21.0	6.64	3214	0.23	76.1		-41.7	
08/30/18	1145	Pump	37.37			21.4	6.56	3150	0.23	86.9		-45.3	
08/30/18	1150	Pump	37.59			22.0	6.51	3273	0.21	81.5		-44.5	
08/30/18	1155	Pump	37.41			22.0	6.51	3285	0.20	80.6		-44.4	
08/30/18	1200	Pump	37.61			22.2	6.48	3374	0.16	74.8		-43.8	
08/30/18	1205	Pump	37.84			20.5	6.46	3382	0.13	87.9		-41.6	
08/30/18	1210	Pump	37.44			20.8	6.46	3325	0.13	84.4		-38.9	
08/30/18	1215	Pump	37.24			21.9	6.48	3317	0.15	76.0		-37.3	
08/30/18	1220	Pump	37.99			21.1	6.50	3219	0.21	70.2		-38.2	
08/30/18	1225	Pump	38.56			20.9	6.56	3181	0.20	81.5		-39.6	
08/30/18	1230	Pump	38.97			20.7	6.54	3008	0.18	69.9		-40.7	
08/30/18	1235	Pump	39.39			21.0	6.53	2957	0.17	58.8		-42.5	
08/30/18	1240	Pump	39.89			20.8	6.59	2964	0.19	58.9		-46.6	
08/30/18	1245	Pump	40.17			20.5	6.63	2971	0.26	64.0		-47.9	
08/30/18	1250	Pump	41.08			20.5	6.67	2942	0.29	61.1		-49.1	
08/30/18	1255	Pump	42.05			20.3	6.68	2833	0.32	54.7		-54.0	
08/30/18	1300	Pump	42.36			20.6	6.60	3013	0.26	50.2		-49.7	
08/30/18	1305	Pump	42.50			20.5	6.61	3015	0.27	45.3		-49.6	
08/30/18	1310	Pump	42.57			20.7	6.58	3120	0.22	40.2		-47.7	
08/30/18	1315	Pump	42.59			20.8	6.52	3231	0.19	33.5		-44.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/30/18	1320	Pump	42.48			20.9	6.52	3234	0.18	30.0		-44.3	SURGE W/ PUMP
08/30/18	1325	Pump	43.28			20.0	7.19	2334	0.63	254		-68.1	
08/30/18	1330	Pump	44.81			20.2	7.00	2562	0.60	113		-60.4	
08/30/18	1335	Pump	45.10			20.2	6.75	2707	0.53	84.9		-56.6	
08/30/18	1340	Pump	44.89			20.6	6.70	2908	0.42	60.8		-52.3	
08/30/18	1345	Pump	44.01	90.0		21.7	6.61	3018	0.36	41.7		-49.4	3 WELL VOLUMES
08/30/18	1350	BAIL											STOP PUMP TO BAIL
08/30/18	1355	BAIL											
08/30/18	1400	Pump	43.32			21.7	6.68	3208	0.53	58.3		-55.5	RESUME PUMPING
08/30/18	1405	Pump	43.26			21.9	6.60	3218	0.49	50.9		-41.1	
08/30/18	1410	Pump	43.14			22.2	6.55	3229	0.40	42.2		-34.7	
08/30/18	1415	Pump	43.38			21.5	6.56	3245	0.39	48.3		-34.2	
08/30/18	1420	Pump	43.84			20.7	6.56	3260	0.32	102		-35.6	SURGE W/ PUMP
08/30/18	1425	Pump	45.67			20.4	6.67	3004	0.56	114		-46.2	
08/30/18	1430	Pump	47.43			20.0	6.81	2768	0.65	120		-53.9	
08/30/18	1435	Pump	47.94			20.5	7.01	2913	0.50	101		-47.8	
08/30/18	1440	Pump	48.09			20.8	7.07	3016	0.64	64.9		-41.1	SURGE W/ PUMP
08/30/18	1445	Pump	48.29			20.8	6.84	2894	0.62	98.5		-59.9	
08/30/18	1450	Pump	48.48			20.8	6.83	2886	0.61	136		-67.2	
08/30/18	1455	Pump	49.09			20.1	6.76	2951	0.60	117		-48.5	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP Radiation ( )	Remarks (odor, clarity, etc.)
08/30/18	1500	Pump	49.46			20.3	6.69	2964	0.60	95.5		-48.5	
08/30/18	1505	Pump	48.98			21.1	6.59	2901	0.45	137		-43.1	
08/30/18	1510	Pump	48.49			21.9	6.53	3334	0.29	214		-39.6	
08/30/18	1515	Pump	48.02			21.6	6.50	3543	0.20	117		-37.0	
08/30/18	1520	Pump	47.48			21.4	6.44	3602	0.11	58.0		-36.1	SURGE W/ PUMP
08/30/18	1525	Pump	48.16			20.3	6.71	2774	0.68	180		-46.1	
08/30/18	1530	Pump	48.46			20.4	6.66	3080	0.59	108		-41.9	
08/30/18	1535	Pump	48.71			20.4	6.59	3181	0.41	72.1		-41.7	
08/30/18	1540	Pump	48.27			22.0	6.59	3228	0.40	69.2		-42.6	SURGE W/ PUMP
08/30/18	1545	Pump	48.99			20.1	6.87	2618	0.78	72.4		-50.7	
08/30/18	1550	Pump	49.90			20.4	6.63	3057	0.47	80.8		-43.7	
08/30/18	1555	Pump	50.40			20.3	6.63	3063	0.46	83.6		-43.4	
08/30/18	1600	Pump	50.38			20.4	6.80	3100	0.48	50.7		-40.9	
08/30/18	1605	Pump	50.13			20.6	6.53	3299	0.30	48.9		-38.3	
08/30/18	1610	Pump	50.02			20.9	6.52	3332	0.27	40.0		-37.9	SURGE W/ PUMP
08/30/18	1615	Pump	50.46			19.7	8.42	1992	1.26	152		-106.6	
08/30/18	1620	Pump	50.75			20.3	6.58	3149	0.40	67.2		-44.5	
08/30/18	1625	Pump	50.28			20.9	6.61	3112	0.42	84.0		-43.6	
08/30/18	1630	Pump	50.57			21.1	6.55	3227	0.32	41.0		-41.1	SURGE W/ PUMP
08/30/18	1635	Pump	51.52			20.3	6.70	2233	0.98	149		-77.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979 16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/30/18	1640	Pump	52.20			20.0	6.76	2768	0.69	87.2		-54.3	
08/30/18	1645	Pump	51.89			21.1	6.67	2937	0.56	69.9		-48.9	
08/30/18	1650	Pump	51.90			20.5	6.85	2682	0.75	181		-57.6	
08/30/18	1655	Pump	52.21			20.9	6.59	3163	0.45	78.1		-43.5	
08/30/18	1700	Pump	52.83			19.6	6.60	3106	0.44	76.0		-40.5	
08/31/18	0745	Pump	28.95			18.9	6.58	3706	0.31	61.2		-47.8	SURGE W/ PUMP
08/31/18	0750	Pump	30.01			19.6	6.51	3683	0.28	204		-34.1	
08/31/18	0755	Pump	30.78			19.4	6.53	3572	0.22	146		-33.7	
08/31/18	0800	Pump	31.68			19.4	6.50	3588	0.17	75.5		-32.7	SURGE W/ PUMP
08/31/18	0805	Pump	32.03			20.1	6.50	3604	0.15	43.4		-33.7	
08/31/18	0810	Pump	33.28			19.5	6.54	3508	0.14	32.0		-37.0	
08/31/18	0815	Pump	33.66			19.8	6.53	3531	0.14	24.1		-37.7	
08/31/18	0820	Pump	33.73			20.1	6.52	3549	0.13	20.4		-38.1	
08/31/18	0825	Pump	33.92			20.1	6.51	3586	0.13	13.5		-38.0	
08/31/18	0830	Pump	33.80			20.2	6.50	3604	0.12	10.2		-38.4	SURGE W/ PUMP
08/31/18	0835	Pump	33.91			20.7	6.49	3635	0.13	14.2		-39.1	
08/31/18	0840	Pump	35.12			19.5	6.54	3489	0.12	15.2		-43.0	
08/31/18	0845	Pump	35.79			20.2	6.54	3486	0.12	15.2		-43.9	
08/31/18	0850	Pump	35.66			20.1	6.53	3520	0.10	19.6		-43.4	
08/31/18	0855	Pump	35.67			20.6	6.53	3525	0.12	13.5		-44.6	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/31/18	0900	Pump	35.97	146.0		20.3	6.50	3585	0.09	9.97		-42.7	2 2/3 DRUMS
08/31/18	0905	Pump	35.15			20.3	6.51	3577	0.09	8.83		-43.3	
08/31/18	0910	Pump	36.13	150.0		20.5	6.51	3587	0.09	7.89		-43.5	~150 GALLONS PURGED

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47		LocID: 47WW45	Date: 08/29/18	
	Project Name: Longhorn Army Ammunition Plant		Project #: 100997916	Recorded By: JM	Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ 4M3667			Water Level Indicator Type/ID #: GEOTECH #6018	
	Equipment Group:			Equipment Group:	
	Development Equipment: TORNADO PUMP & BAILER			Equipment Decon.: ALCONOX & BUCKET	
WELL INFO	Casing I.D. (in) [a]: 47WW45		Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 19.22' BTOC	
	Total Well Depth (ft) [d]: 48.87' BTOC		Water Column Thickness (ft) [d-c]: 29.65'	Well Volume (gal) {[d-c] x b}: 38.32	
	Ground Condition of Well: SOFT			Remarks: SLOW RECHARGE	

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/29/18	0805	Pump	21.03	1.5	0.3	19.4	12.21	1775	2.99	>1100		31.5	DARK, THICK W/ SEDIMENT
08/29/18	0810	Pump	24.64	3.0	0.3	19.5	12.23	1407	2.06	>1100		-7.8	MOVE PUMP TO BOTTOM
08/29/18	0815	Pump	27.59	4.5	0.3	19.6	12.16	1708	1.34	>1100		-16.2	SURGE W/ PUMP
08/29/18	0820	Pump	31.11	6.0	0.3	19.1	12.30	2830	4.76	>1100		-32.9	SLOW PUMP RATE
08/29/18	0825	Pump	36.12	7.5	0.3	19.2	12.38	3211	4.76	>1100		-37.0	SURGE W/ PUMP
08/29/18	0830	Pump	37.49	9.0	0.3	20.4	12.39	3073	4.24	>1100		-43.5	
08/29/18	0835	Pump	39.89	10.5	0.3	19.6	12.44	3185	4.22	>1100		-44.0	SURGE W/ PUMP
08/29/18	0840	Pump	42.41	12.0	0.3	20.1	12.44	3234	4.05	>1100		-42.7	SLOW PUMP RATE
08/29/18	0845	Pump	42.29	13.5	0.3	20.3	12.44	3246	3.93	>1100		-42.2	
08/29/18	0850	Pump	42.39	15.0	0.3	21.0	12.43	3254	3.71	850		-41.7	
08/29/18	0855	Pump	43.25	16.5	0.3	21.6	12.41	3212	3.64	132		-40.4	
08/29/18	0900	Pump	43.76	18.0	0.3	22.1	12.40	3210	3.78	159		-39.7	STOP PUMP TO BAIL & ALLOW RECHARGE

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

0940 - STOP DEVELOPMENT TO FLUSH WELL

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/31/18	1035	Pump	20.63		0.14	20.3	12.18	2576	0.52	43.5		30.9	CONTINUE DEVELOPMENT
08/31/18	1040	Pump	21.26			23.9	12.06	2548	0.30	27.8		1.0	SURGE W/ PUMP
08/31/18	1045	Pump	22.71			22.9	12.14	2537	0.19	199		-23.0	
08/31/18	1050	Pump	24.10			21.9	12.19	2567	0.17	134		-30.1	
08/31/18	1055	Pump	25.44			20.8	12.19	2573	0.17	67.2		-36.3	SURGE W/ PUMP
08/31/18	1100	Pump	26.61			24.0	12.16	2566	0.16	40.0		-43.0	
08/31/18	1105	Pump	27.22			22.1	12.20	2565	0.14	98.7		-46.9	
08/31/18	1110	Pump	29.40			20.8	12.25	2579	0.12	26.9		-51.1	SURGE W/ PUMP
08/31/18	1115	Pump	29.93			22.6	12.23	2572	0.12	86.5		-57.6	
08/31/18	1120	Pump	30.34			27.9	12.11	2548	0.09	15.1		-60.0	
08/31/18	1125	Pump	30.94			23.7	12.19	2575	0.11	21.6		-63.4	
08/31/18	1130	Pump	32.19			21.2	12.25	2567	0.08	23.8		-57.2	
08/31/18	1135	Pump	32.55			25.6	12.16	2550	0.06	22.9		-59.7	
08/31/18	1140	Pump	32.97			22.7	12.23	2572	0.20	17.5		-45.1	
08/31/18	1145	Pump	33.49			22.9	12.21	2572	0.17	15.2		-44.5	STOP PUMP TO BAIL
08/31/18	1150	BAIL											
08/31/18	1155	BAIL											
08/31/18	1200	Pump	33.92			24.7	12.22	2584	0.35	38.1		-40.5	CONTINUE PUMPING
08/31/18	1205	Pump	35.10			23.5	12.23	2585	0.32	31.4		-32.4	
08/31/18	1210	Pump	37.10	↓	↓	20.9	12.28	2595	0.35	34.9		-28.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/31/18	1215	Pump	37.61	↓	↓	13.8	12.20	2590	0.37	42.2		-18.0	
08/31/18	1220	Pump	38.59			21.9	12.25	2594	0.40	36.9		-21.7	
08/31/18	1225	Pump	39.53			23.0	12.22	2584	0.46	33.1		-14.8	
08/31/18	1230	Pump	39.96			22.5	12.24	2583	0.51	44.3		-11.3	
08/31/18	1235	Pump	41.86			21.3	12.27	2585	0.82	32.6		-4.6	
08/31/18	1240	Pump	43.28			22.3	12.24	2561	1.09	30.7		-1.2	
08/31/18	1245	Pump	43.57	↓	↓	22.7	12.22	2569	1.24	62.5		0.3	
08/31/18	1250	Pump	44.68	36.0	0.44	21.3	12.26	2572	1.25	33.9		0.5	2 WELL VOLUMES
08/31/18	1255	Pump	45.81			22.4	12.24	2560	1.39	29.8		0.8	
08/31/18	1300	Pump	46.74			21.8	12.24	2544	1.36	23.9		1.7	
08/31/18	1305	Pump	47.53			22.5	12.20	2473	1.97			2.0	
08/31/18	1310	Pump											WELL RAN DRY, WILL RETURN FOR WATER LEVEL

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/05/18	1140	Pump	13.64		0.13	26.2	8.84	629	4.81	29.4		89.3	RESUME DEVELOPMENT AFTER FLUSHING WELL
09/05/18	1145	Pump	17.54			27.4	8.80	629	4.39	22.0		80.2	
09/05/18	1150	Pump	17.73			27.4	8.86	634	4.57	21.6		69.6	
09/05/18	1155	Pump	19.89			26.3	8.77	629	4.90	34.5		68.5	SURGE W/ PUMP
09/05/18	1200	Pump	22.58			26.3	8.86	631	4.73	86.1		60.3	
09/05/18	1205	Pump	23.14			27.5	9.08	637	4.48	81.9		51.8	
09/05/18	1210	Pump	23.56			26.1	9.25	644	4.44	81.4		59.1	SURGE W/ PUMP
09/05/18	1215	Pump	24.32			25.7	9.48	657	4.31	80.6		57.8	
09/05/18	1220	Pump	24.78			25.8	9.53	664	4.17	75.2		58.2	
09/05/18	1225	Pump	25.23			26.4	9.66	678	4.00	69.9		55.4	SURGE W/ PUMP
09/05/18	1230	Pump	25.54			26.0	9.83	687	3.98	53.9		54.9	
09/05/18	1235	Pump											
09/05/18	1240	Pump											
09/05/18	1245	Pump	24.75			24.9	9.85	703	3.99	54.6		76.2	SURGE W/ PUMP
09/05/18	1250	Pump	25.70			24.7	9.92	723	4.06	52.9		73.1	
09/05/18	1255	Pump	27.40			24.5	10.10	743	3.93	57.4		69.6	
09/05/18	1300	Pump	29.61			24.1	10.09	743	3.98	56.1		63.4	SURGE W/ PUMP
09/05/18	1305	Pump	30.12			24.0	10.09	741	3.87	53.8		61.3	
09/05/18	1310	Pump	31.25			23.8	10.18	759	3.77	55.3		59.9	
09/05/18	1315	Pump	31.81	↓	↓	23.9	10.23	778	3.64	73.1		58.5	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/05/18	1320	Pump	31.84	↓	0.13	24.4	10.36	794	3.42	82.9		53.5	Surge w/ Pump
09/05/18	1325	Pump	32.12		↓	23.9	10.48	832	3.34	77.0		52.2	
09/05/18	1330	Pump	32.47			23.9	10.53	854	3.21	80.8		51.2	
09/05/18	1335	Pump	32.68			23.9	10.61	874	3.11	80.0		48.5	Surge w/ Pump
09/05/18	1340	Pump	32.96			24.7	10.68	899	3.04	92.3		46.1	
09/05/18	1345	Pump	33.22	↓	↓	24.9	10.83	945	2.83	96.0		41.6	Surge w/ Pump
09/05/18	1350	Pump	33.50	73.0	0.13	24.4	10.90	965	2.65	91.7		38.0	Stop Pump to Bail
09/05/18	1355	Bail											
09/05/18	1400	Bail											Resume Pumping
09/05/18	1405	Pump	33.49			23.5	11.01	1032	2.83	126		44.6	
09/05/18	1410	Pump	33.98			23.2	11.10	1082	2.32	176		36.5	
09/05/18	1415	Pump	34.57			23.0	11.14	1106	2.48	129		33.8	Surge w/ Pump
09/05/18	1420	Pump	34.82			22.9	11.19	1134	2.31	137		30.9	
09/05/18	1425	Pump	35.08			23.0	11.23	1159	2.29	159		29.3	Surge w/ Pump
09/05/18	1430	Pump	34.92			23.9	11.24	1156	2.08	162		26.8	
09/05/18	1435	Pump	34.96			23.0	11.32	1212	1.98	123		25.0	Surge w/ Pump
09/05/18	1440	Pump	35.00			22.9	11.34	1251	1.99	134		24.2	
09/05/18	1445	Pump	35.00			22.9	11.37	1247	1.92	129		22.4	Surge w/ Pump
09/05/18	1450	Pump	34.80			23.0	11.40	1295	1.77	101		20.7	
09/05/18	1455	Pump	34.80			22.9	11.43	1323	1.68	106		19.6	Surge w/ Pump

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 1009796

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/05/18	1500	Pump	34.75			22.7	11.45	1361	1.59	95.6		18.8	Surge w/ Pump
09/05/18	1505	Pump	34.58			23.1	11.45	1392	1.61	99.7		18.8	
09/05/18	1510	Pump	34.80			22.5	11.48	1387	1.54	84.7		19.1	Surge w/ Pump
09/05/18	1515	Pump	34.53			23.5	11.47	1405	1.39	97.6		17.6	
09/05/18	1520	Pump	34.65			22.3	11.51	1427	1.36	83.8		18.2	Surge w/ Pump
09/05/18	1525	Pump	34.55			22.6	11.51	1444	1.28	86.2		17.8	
09/05/18	1530	Pump	34.57			22.3	11.52	1452	1.30	70.4		18.5	
09/05/18	1535	Pump				22.9	11.52	1467	1.22			17.7	Having issues w/ Pump
09/05/18	1550	Pump	32.70			22.0	11.52	1538	1.16	71.5		18.2	Continue Pumping
09/05/18	1555	Pump	32.99			22.3	11.52	1527	1.09	69.5		14.4	
09/05/18	1600	Pump	33.01			22.6	11.52	1523	1.06	75.1		10.8	Surge w/ Pump
09/05/18	1605	Pump	33.14			22.7	11.53	1529	1.02	73.1		8.9	
09/05/18	1610	Pump	33.99			22.1	11.55	1546	1.05	99.8		8.7	
09/05/18	1615	Pump	34.21			21.9	11.53	1526	1.04	109		8.2	Surge w/ Pump
09/05/18	1620	Pump	34.39			22.5	11.51	1516	1.03	131		7.8	
09/05/18	1625	Pump	34.49			22.0	11.54	1527	1.03	155		7.5	Surge w/ Pump
09/05/18	1630	Pump				21.6	11.55	1530	1.10	145		7.6	
09/06/18	0740	Pump	23.45			19.8	11.62	1685	0.50	17.1		43.0	
09/06/18	0745	Pump	24.89			20.0	11.64	1648	0.53	12.1		22.4	Surge w/ Pump
09/06/18	0750	Pump				20.3	11.64	1623	0.60	44.7		19.0	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/05/18	0755	Pump	25.92			20.3	11.66	1620	0.64	1090		12.4	
09/05/18	0800	Pump	28.18			19.9	11.67	1643	0.59	165		9.7	
09/05/18	0805	Pump	29.52	110.0		19.8	11.66	1638	0.66	187		6.3	STOP PUMP TO BAIL
09/05/18	0810	BAIL											
09/05/18	0815	BAIL	30.37										RESUME PUMPING
09/05/18	0820	Pump	31.04			19.9	11.72	1695	0.81	125		14.6	
09/05/18	0825	Pump	33.48			19.7	11.72	1697	0.81			11.1	
09/05/18	0830												LET PUMP REST
09/05/18	0840	Pump	31.39			20.7	11.74	1770	1.00	197		23.3	RESUME PUMPING
09/05/18	0845	Pump	32.54			20.2	11.71	1750	0.83	100		10.6	SURGE W/ PUMP
09/05/18	0850	Pump	33.32			20.5	11.70	1740	0.81	82.3		-0.3	
09/05/18	0855	Pump	33.67			20.4	11.73	1752	0.80	84.7		-8.7	
09/05/18	0900	Pump	33.76			20.7	11.72	1758	0.73	71.0		-17.4	SURGE W/ PUMP
09/05/18	0905	Pump	33.96			20.6	11.71	1763	0.79	113		-19.7	
09/05/18	0910	Pump	34.37			20.7	11.72	1776	0.78	91.2		-22.6	SURGE W/ PUMP
09/05/18	0915	Pump	34.55			20.7	11.70	1773	0.76	86.4		-24.1	
09/05/18	0920	Pump	34.36			21.4	11.68	1770	0.72	82.9		-25.6	
09/05/18	0925	Pump							0.71				LET PUMP REST
09/05/18	0930	Pump	34.54			20.4	11.64	1740	0.75	97.3		-14.6	RESUME PUMPING
09/05/18	0935	Pump	35.73			20.5	11.62	1735	0.72	93.5		-18.1	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979 16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/06/18	0940	Pump				21.1	11.61	1737	0.74			-27.8	
													LET PUMP REST
09/06/18	1010	Pump	33.40	128.0		21.0	11.50	1766	0.72	123		23.3	
09/06/18	1015	Pump	33.62			20.8	11.47	1725	0.50	106		9.3	
09/06/18	1020	Pump	34.98			21.6	11.48	1725	0.62	116		-4.6	
09/06/18	1025	Pump	35.35			21.6	11.48	1732	0.62	115		-8.3	
09/06/18	1030	Pump	35.94			21.0	11.48	1727	0.67	~~106~~ 106		-10.4	
09/06/18	1035	Pump	36.75			21.7	11.42	1721	0.66	95.3		-19.6	
09/06/18	1040	Pump	36.98			21.1	11.42	1708	0.60	74.2		-21.6	
09/06/18	1045	Pump	37.60			21.2	11.42	1711	0.56	64.9		-23.3	
09/06/18	1050	Pump	37.59			22.1	11.41	1721	0.56	61.7		-25.0	
09/06/18	1055	Pump	37.98			21.9	11.37	1717	0.54	55.3		-26.0	
09/06/18	1100	Pump	38.40			22.0	11.35	1718	0.55	48.7		-24.9	
09/06/18	1105	Pump	38.98			21.7	11.30	1708	0.54	44.8		-22.4	
09/06/18	1110	Pump	38.49			21.8	11.30	1712	0.49	40.7		-21.6	
09/06/18	1115	Pump	38.28			22.1	11.26	1712	0.48	39.1		-20.4	
09/06/18	1120	Pump	38.58			22.1	11.25	1714	0.48	37.7		-19.7	
09/06/18	1125	Pump	39.62			22.1	11.20	1711	0.46	34.0		-18.7	
09/06/18	1130	Pump	39.60			22.7	11.19	1714	0.43	30.0		-19.2	
09/06/18	1135	Pump	39.50			23.9	11.14	1715	0.44	28.9		-22.0	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
09/06/18	1140	Pump	39.43			23.3	11.11	1717	0.41	29.9		-27.2	
09/06/18	1145	Pump	39.56			22.3	11.11	1721	0.39	22.9		-35.9	
09/06/18	1150	Pump	39.61			24.3	11.03	1719	0.38	22.8		-33.1	SURGE w/ PUMP
09/06/18	1155	Pump	39.45			22.0	11.52	1997	0.27	172		-7.4	
09/06/18	1200	Pump	39.49			21.9	11.51	1975	0.27	81.1		-6.6	
09/06/18	1205	Pump	39.85			21.7	11.21	1756	0.33	56.5		-3.2	
09/06/18	1210	Pump	39.92			21.8	11.10	1735	0.34	36.4		-2.9	
09/06/18	1215	Pump	40.00			21.4	11.09	1731	0.36	27.2		-4.5	
09/06/18	1220	Pump	40.19			21.8	11.00	1721	0.36	23.7		-7.9	
09/06/18	1225	Pump	40.05			22.3	11.02	1733	0.35	23.1		-13.0	
09/06/18	1230	Pump	39.60			22.1	11.02	1736	0.33	23.4		-18.9	
09/06/18	1235	Pump	39.38			21.9	11.02	1748	0.32	24.2		-22.4	
09/06/18	1240	Pump	39.20			21.9	10.97	1742	0.32	35.6		-22.2	
09/06/18	1245	Pump	39.40			21.5	10.92	1723	0.32	39.8		-23.6	
09/06/18	1250	Pump	39.50			21.3	10.86	1711	0.30	47.1		-26.5	
09/06/18	1255	Pump	40.01			21.2	10.79	1701	0.29	52.7		-30.3	
09/06/18	1300	Pump	39.80			21.6	10.82	1705	0.29	61.9		-34.4	
09/06/18	1305	Pump	39.73			21.4	10.82	1700	0.28	65.2		-36.2	SURGE w/ PUMP
09/06/18	1310	Pump	39.81			21.7	10.70	1674	0.30	92.7		-38.1	
09/06/18	1315	Pump	39.20			22.8	10.66	1663	0.29	86.1		-42.1	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47MW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/06/18	1320	Pump	38.00			23.8	10.66	1669	0.28	94.4		-42.8	
09/06/18	1325	Pump	38.11			21.8	10.70	1675	0.26	101		-37.9	
09/06/18	1330	Pump	38.22			21.6	10.66	1674	0.25	89.7		-34.6	SURGE w/ PUMP
09/06/18	1335	Pump	38.15			22.1	10.62	1668	0.24	88.8		-36.2	
09/06/18	1340	Pump	37.62			23.3	10.67	1658	0.30	85.5		-42.9	
09/06/18	1345	Pump	37.30			21.7	10.59	1660	0.28	88.5		-43.0	
09/06/18	1350	Pump	37.42			22.4	10.47	1651	0.29	77.8		-41.2	SURGE w/ PUMP
09/06/18	1355	Pump	37.36			22.0	10.51	1665	0.27	90.4		-34.5	
09/06/18	1400	Pump	38.04			21.1	10.42	1664	0.25	67.0		-31.6	
09/06/18	1405	Pump	38.10			21.4	10.43	1669	0.24	64.1		-28.7	
09/06/18	1410	Pump	38.00			20.2	10.46	1680	0.24	57.9		-15.8	
09/06/18	1415	Pump	39.59			20.9	10.39	1682	0.23	57.7		-14.3	
09/06/18	1420	Pump	39.40			21.6	10.40	1693	0.22	58.7		-11.7	
09/06/18	1425	Pump	39.81			21.5	10.44	1698	0.22	43.7		-9.9	
09/06/18	1430	Pump	40.43			20.9	10.43	1698	0.24	50.2		-7.2	
09/06/18	1435	Pump	40.55			21.6	10.44	1700	0.23	43.5		-7.2	
09/06/18	1440	Pump	40.51			21.7	10.44	1704	0.22	40.5		-6.3	SURGE w/ PUMP
09/06/18	1445	Pump	40.70			20.8	11.12	1856	0.17	90.5		-7.7	
09/06/18	1450	Pump	40.43			22.1	10.82	1766	0.20	52.0		-8.5	
09/06/18	1455	Pump	40.42			21.4	10.61	1737	0.21	50.2		-4.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/06/18	1500	Pump	40.67			20.9	10.53	1730	0.23	52.9		-2.3	
09/06/18	1505	Pump	40.00			20.9	10.48	1739	0.22	48.0		7.3	
09/06/18	1510	Pump	40.18			21.1	10.51	1738	0.22	46.1		7.9	
09/06/18	1515	Pump	40.29			21.2	10.40	1736	0.22	43.4		9.5	
09/06/18	1520	Pump	40.61			20.7	10.36	1734	0.21	41.4		11.5	
09/06/18	1525	Pump	40.66			21.4	10.34	1734	0.21	37.5		13.5	
09/06/18	1530	Pump	40.65			21.1	10.34	1739	0.20	34.6		16.1	
09/06/18	1535	Pump	40.66			21.3	10.32	1745	0.18	33.3		18.8	
09/06/18	1540	Pump	40.67			21.2	10.30	1749	0.18	32.7		20.9	
09/06/18	1545	Pump	40.44			21.4	10.30	1750	0.18	27.1		24.2	
09/06/18	1550	Pump	40.53			21.3	10.31	1754	0.18	26.4		25.4	
09/06/18	1555	Pump	40.76			20.8	10.30	1756	0.17	22.9		28.6	
09/06/18	1600	Pump	40.72			21.1	10.28	1757	0.16	19.4		29.4	
09/06/18	1605	Pump	40.67			21.3	10.26	1765	0.16	17.6		31.4	
09/06/18	1610	Pump	40.66			21.3	10.25	1764	0.17	17.8		31.9	
09/06/18	1615	Pump	40.61			21.4	10.25	1768	0.16	15.1		32.2	
09/06/18	1620	Pump				21.3	10.23	1772	0.16	12.9		33.9	
09/06/18	1625	Pump				20.9	10.22	1774	0.16	11.0		35.0	
09/06/18	1630	Pump	40.64			21.4	10.21	1774	0.16	11.7		35.4	
09/06/18	1635	Pump	40.72			21.2	10.21	1775	0.16	11.6		36.6	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/06/18	1640	Pump				21.2	10.20	1781	0.16	9.99		37.5	
09/06/18	1645	Pump				21.0	10.19	1782	0.16	9.83		38.2	
09/06/18	1650	Pump				21.0	10.19	1783	0.16	9.45		38.5	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW46	Date: 09/04/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M3667		Water Level Indicator Type/ID #: GEOTECH #6018
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKET
WELL INFO	Casing I.D. (in) [a]: 47WW46	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 20.64' BTOC
	Total Well Depth (ft) [d]: 53.23' BTOC	Water Column Thickness (ft) [d-c]: 32.59'	Well Volume (gal) ([d-c] x b): 17.82
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/04/18	0830	Pump	23.18		0.26	19.6	8.83	675	1.01	>1100		112.3	
09/04/18	0835	Pump	23.65			19.7	9.19	602	1.18	>1100		108.9	SURGE W/ PUMP
09/04/18	0840	Pump	23.34			20.0	9.45	713	1.71	>1100		100.9	
09/04/18	0845	Pump	23.52			19.8	8.28	1287	1.62	>1100		110.0	SURGE W/ PUMP
09/04/18	0850	Pump	23.53			19.9	7.82	2140	1.69	>1100		107.7	
09/04/18	0855	Pump	23.51			19.7	7.39	2274	1.19	>1100		89.3	SURGE W/ PUMP
09/04/18	0900	Pump	23.35			20.0	7.11	2586	0.94	>1100		5.4	
09/04/18	0905	Pump	23.20			19.8	7.03	2881	0.77	>1100		-15.9	SURGE W/ PUMP
09/04/18	0910	Pump	23.24			19.9	6.96	3240	0.56	882		-37.9	
09/04/18	0915	Pump	23.68			20.0	6.95	3289	0.50	695		-42.6	SURGE W/ PUMP
09/04/18	0920	Pump	23.98			19.8	6.94	3386	0.43	535		-46.2	
09/04/18	0925	Pump	23.49	↓	↓	19.7	6.92	3568	0.33	310		-51.0	SURGE W/ PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW46
	Project Name: Longhorn Army Ammunition Plant	Project #: 160979 16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/04/18	0930	Pump	23.39	↓	↓	19.9	6.95	3452	0.40	491		-53.4	
09/04/18	0935	Pump	23.64	18.0	0.26	19.6	6.92	3558	0.34	244		-54.3	SURGE w/ PUMP
09/04/18	0940	Pump	23.63	|	0.36	20.0	6.92	3552	0.35	363		-55.5	
09/04/18	0945	Pump	23.68	|	|	19.7	6.92	3613	0.31	234		-55.2	SURGE w/ PUMP
09/04/18	0950	Pump	23.58	|	|	20.0	6.92	3651	0.30	225		-56.9	
09/04/18	0955	Pump	23.64	|	|	19.8	6.91	3685	0.29	201		-56.5	SURGE w/ PUMP
09/04/18	1000	Pump	23.65	|	|	19.7	6.91	3674	0.29	219		-56.4	
09/04/18	1005	Pump	23.66	|	|	19.7	6.91	3697	0.29	169		-57.5	SURGE w/ PUMP
09/04/18	1010	Pump	23.60	|	|	19.8	6.91	3685	0.28	345		-57.5	
09/04/18	1015	Pump	23.63	|	|	19.8	6.90	3811	0.22	169		-58.0	SURGE w/ PUMP
09/04/18	1020	Pump	23.66	↓	↓	19.7	6.90	3784	0.22	225		-58.0	
09/04/18	1025	Pump	23.64	36.0	0.36	19.7	6.90	3845	0.20	225		-59.2	STOP PUMP TO BAIL
09/04/18	1030	BAIL		|								
09/04/18	1035	BAIL	23.46	|									RESUME PUMPING
09/04/18	1040	Pump	23.71	|	0.36	19.8	6.95	3565	0.63	256		-44.5	
09/04/18	1045	Pump	24.01	|	|	19.7	6.94	3582	0.57	269		-43.9	
09/04/18	1050	Pump	23.68	|	|	20.0	6.93	3611	0.53	247		-45.1	
09/04/18	1055	Pump	23.67	|	|	19.9	6.91	3755	0.36	144		-48.5	SURGE w/ PUMP
09/04/18	1100	Pump	23.95	|	|	19.8	6.91	3704	0.38	480		-49.0	
09/04/18	1105	Pump	24.18	↓	↓	19.6	6.89	3893	0.24	189		-50.9	SURGE w/ PUMP

ONE WELL VOLUME

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47GW046
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
09/04/18	1110	Pump	23.69		0.36	19.7	6.91	3813	0.26	239		-49.5	
09/04/18	1115	Pump	23.09			20.0	6.90	3862	0.25	147		-51.5	Surge w/ Pump
09/04/18	1120	Pump	23.76			19.6	6.96	3814	0.28	272		-39.4	
09/04/18	1125	Pump	23.78	55.0	0.36	20.0	6.90	3828	0.30	261		-42.3	
09/04/18	1130	Pump	23.66			19.8	6.89	3917	0.22	142		-47.6	Surge w/ Pump
09/04/18	1135	Pump	23.63			19.9	6.89	3919	0.21	158		-49.3	
09/04/18	1140	Pump	23.68			19.9	6.89	3952	0.18	111		-51.6	Surge w/ Pump
09/04/18	1145	Pump	23.54		0.36	20.2	6.92	3785	0.55	137		-52.8	2 well volumes
09/04/18	1150	Bail											
09/04/18	1155	Bail	23.29										
09/04/18	1200	Pump	23.89		0.36	19.8	6.90	3830	0.38	172		-38.0	
09/04/18	1205	Pump	23.50			20.1	6.89	3902	0.31	179		-42.5	Surge w/ Pump
09/04/18	1210	Pump	23.36			20.6	6.92	3795	0.38	183		-45.0	
09/04/18	1215	Pump	23.60			20.0	6.89	3944	0.24	120		-46.0	
09/04/18	1220	Pump	23.71			20.0	6.89	3954	0.21	77.3		-48.3	Surge w/ Pump
09/04/18	1225	Pump	23.69	73.0	0.36	20.0	6.88	4026	0.17	82.1		-50.0	
09/04/18	1230	Pump	23.78		0.30	19.9	6.88	4039	0.16	69.3		-51.1	
09/04/18	1235	Pump	23.64			20.1	6.88	4033	0.16	65.6		-51.9	Surge w/ Pump
09/04/18	1240	Pump	23.58			20.0	6.88	4003	0.16	82.2		-51.3	
09/04/18	1245	Pump	23.71			20.0	6.88	4024	0.15	58.4		-53.0	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW46
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
09/04/18	1250	Pump	23.73	↓	↓	20.2	6.88	4023	0.15	52.3		-53.3	SURGE w/ PUMP
09/04/18	1255	Pump	23.77			19.9	6.88	3971	0.15	68.8		-52.8	
09/04/18	1300	Pump	23.75			19.9	6.88	4055	0.13	46.9		-54.3	
09/04/18	1305	Pump	23.78			19.8	6.88	4052	0.13	41.6		-54.6	SURGE w/ PUMP
09/04/18	1310	Pump	23.10			20.2	7.01	3971	0.30	150		-40.8	
09/04/18	1315	Pump	23.33			20.0	6.88	4020	0.21	142		-36.0	3 WELL VOLUMES
09/04/18	1320	Pump	23.71			20.1	6.88	4016	0.19	178		-40.0	
09/04/18	1325	Pump	23.68	91.0	0.30	20.0	6.88	4022	0.17	176		-42.0	STOP PUMP TO BAIL
09/04/18	1330	~~Bail~~											
09/04/18	1335	~~Bail~~	23.35										
09/04/18	1340	Pump	23.79		0.45	20.0	6.89	3854	0.46	290		-30.0	RESUME PUMPING
09/04/18	1345	Pump	23.92			19.9	6.89	3887	0.37	292		-34.2	
09/04/18	1350	Pump	24.00			19.8	6.92	3961	0.30	186		-35.1	
09/04/18	1355	Pump	23.68			20.1	6.89	3970	0.23	119		-37.4	
09/04/18	1400	Pump	23.59			20.1	6.88	4063	0.16	73.7		-42.5	SURGE w/ PUMP
09/04/18	1405	Pump	23.82			19.8	6.88	4032	0.16	99.5		-43.2	
09/04/18	1410	Pump	24.10			19.8	6.88	4092	0.15	67.8		-46.2	
09/04/18	1415	Pump	23.84	↓	↓	19.8	6.88	4081	0.13	52.7		-47.3	SURGE w/ PUMP
09/04/18	1420	Pump	23.85	110.0	0.45	20.1	6.88	4092	0.13	43.3		-48.3	
09/04/18	1425	Pump	23.83	↓	0.36	20.0	6.88	4064	0.12	54.3		-48.4	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW46
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/04/18	1430	Pump	23.82	↓	0.36	20.2	6.88	4083	0.12	54.6		-49.2	
09/04/18	1435	Pump	23.71	↓	↓	20.0	6.88	4091	0.11	43.3		-49.9	
09/04/18	1440	Pump	23.76	↓	↓	19.9	6.88	4109	0.11	31.4		-50.7	
09/04/18	1445	Pump	23.77	↓	↓	20.0	6.88	4128	0.11	24.9		-51.5	SURGE w/ PUMP
09/04/18	1450	Pump	23.82	↓	↓	20.2	6.88	4089	0.09	48.8		-51.6	
09/04/18	1455	Pump	23.68	↓	↓	20.0	6.87	4120	0.09	44.4		-52.2	
09/04/18	1500	Pump	23.74	↓	↓	20.2	6.88	4086	0.09	42.1		-52.1	
09/04/18	1505	Pump	23.73	↓	↓	19.9	6.88	4117	0.09	29.0		-52.6	
09/04/18	1510	Pump	23.72	128.0	0.36	19.8	6.88	4130	0.08	27.2		-53.1	
09/04/18	1515	Pump	23.73	↓	↓	20.1	6.88	4146	0.08	25.9		-53.8	
09/04/18	1520	Pump	23.74	↓	↓	20.0	6.88	4148	0.08	32.0		-54.0	
09/04/18	1525	Pump	23.76	↓	↓	19.9	6.88	4141	0.08	36.6		-54.4	
09/04/18	1580	Pump	23.98	↓	↓	19.9	6.88	4127	0.08	44.5		-54.3	
09/04/18	1535	Pump	24.02	↓	↓	19.9	6.88	4137	0.08	55.5		-54.8	
09/04/18	1540	Pump	24.24	↓	↓	19.9	6.88	4097	0.08	60.4		-54.4	SURGE w/ PUMP
09/04/18	1545	Pump	23.58	↓	↓	20.4	6.87	4185	0.08	54.0		-55.8	
09/04/18	1550	Pump	23.70	↓	↓	20.1	6.87	4163	0.08	56.5		-55.8	
09/04/18	1555	Pump	23.66	↓	↓	20.2	6.88	4151	0.09	52.6		-55.7	
09/04/18	1600	Pump	23.67	146.0	0.36	20.0	6.88	4151	0.08	38.9		-55.7	
09/04/18	1605	Pump	23.58	↓	0.30	20.2	6.88	4162	0.08	30.9		-56.3	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW46
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/04/18	1610	Pump	23.62	↓	0.30	20.1	6.88	4167	0.08	26.7		-56.4	
09/04/18	1615	Pump	23.60		↓	20.1	6.87	4178	0.07	27.0		-56.8	
09/04/18	1620	Pump	23.58			20.0	6.88	4176	0.07	25.9		-57.0	
09/04/18	1625	Pump	23.59			20.4	6.88	4187	0.07	27.6		-57.3	
09/04/18	1630	Pump	22.47			20.1	6.88	4164	0.07	30.5		-53.3	
09/04/18	1635	Pump	23.35			20.5	6.87	4192	0.07	38.4		-55.0	
09/04/18	1640	Pump	23.21			20.6	6.87	4199	0.07	41.6		-56.0	
09/04/18	1645	Pump	23.61			20.4	6.87	4169	0.07	47.0		-55.6	STOP PUMPING. WILL RETURN IN AM
09/05/18	0745	Pump	23.25			19.5	7.07	4106	0.45	1.41		-22.0	SURGE W/ PUMP
09/05/18	0750	Pump	23.81	↓	↓	19.5	6.91	4107	0.29	>1100		-30.9	
09/05/18	0755	Pump	23.92	165.0	0.30	19.4	6.91	3665	0.21	53.6		-37.4	
09/05/18	0800	Pump	24.19	↓	0.50	19.4	6.91	4125	0.17	32.7		-40.1	
09/05/18	0805	Pump	23.75		↓	19.5	6.90	4167	0.15	16.4		-44.9	
09/05/18	0810	Pump	23.70			19.5	6.90	4171	0.12	10.1		-47.0	
09/05/18	0815	Pump	23.69			19.6	6.90	4176	0.10	6.39		-49.3	
09/05/18	0820	Pump	23.70	↓	↓	19.5	6.90	4191	0.10	5.07		-51.3	
09/05/18	0825	Pump	23.71	180.0	0.50	19.5	6.90	4198	0.10	4.12		-52.1	4¼ DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW47	Date: 08/31/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979.16	Recorded By: JM Checked By: EN
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ 4M3667		Water Level Indicator Type/ID #: GEOTECH #6018
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP & BAILER		Equipment Decon.: ALCONOX & BUCKETS
WELL INFO	Casing I.D. (in) [a]: 47WW47	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 18.97 BTOC
	Total Well Depth (ft) [d]: 55.71' BTOC	Water Column Thickness (ft) [d-c]: 36.74'	Well Volume (gal) ([d-c] x b): 30.55
	Ground Condition of Well: SOFT		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/31/18	1410	Pump	21.18	1.0	0.2	19.7	9.97	639	0.27	>1100		52.0	
08/31/18	1415	Pump	22.91	2.0		21.4	9.71	559	0.41	>1100		59.9	SURGE w/ PUMP
08/31/18	1420	Pump	22.84	3.0		22.7	9.80	563	0.60	>1100		58.6	
08/31/18	1425	Pump	25.10	4.0		20.9	10.65	625	1.43	>1100		50.2	SURGE w/ PUMP
08/31/18	1430	Pump	24.96	5.0		21.2	11.39	853	1.94	>1100		31.1	
08/31/18	1435	Pump	28.48	6.0		20.7	12.42	2724	2.76	>1100		-14.0	SURGE w/ PUMP
08/31/18	1440	Pump	28.34	7.0		23.0	12.43	4508	2.66	>1100		-18.3	
08/31/18	1445	Pump	28.85	8.0		21.2	12.47	3922	2.71	>1100		-19.2	
08/31/18	1450	Pump	29.74	9.0		20.8	12.52	4364	2.65	>1100		-23.2	SURGE w/ PUMP
08/31/18	1455	Pump	29.43	10.0		23.2	12.42	3978	2.19	>1100		-27.9	
08/31/18	1500	Pump	29.61	11.0		22.7	12.42	3275	1.92	>1100		-29.3	
08/31/18	1505	Pump	31.58	12.0	↓	20.5	12.41	3535	2.22	>1100		-35.1	SURGE w/ PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47NW47
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/31/18	1510	Pump	31.53	13.0	1	20.9	12.37	3458	2.28	>1100		-37.0	
08/31/18	1515	Pump	30.88	14.0		21.7	12.31	3236	2.16	>1100		-42.1	SURGE W/ PUMP
08/31/18	1520	Pump	31.30	15.0		20.5	12.32	3481	2.07	>1100		-45.0	
08/31/18	1525	Pump	31.68	16.0		20.5	12.14	3108	1.69	>1100		-52.2	SURGE W/PUMP
08/31/18	1530	Pump	31.74	17.0		20.0	11.81	2681	1.51	>1100		-54.7	
08/31/18	1535	Pump	31.97	18.0	0.2	20.2	11.04	2723	1.19	>1100		-48.2	SURGE W/ PUMP
08/31/18	1540	Pump	31.89		0.3	20.6	10.63	3291	0.89	>1100		-36.6	
08/31/18	1545	Pump	32.16			20.1	9.96	3252	0.84	>1100		-31.3	SURGE W/ PUMP
08/31/18	1550	Pump	32.49			20.4	9.95	3386	0.83	>1100		-23.9	
08/31/18	1555	Pump	32.70			20.2	9.80	3438	0.78	>1100		-21.2	SURGE W/ PUMP
08/31/18	1600	Pump	32.80			20.7	9.36	3627	0.62	>1100		-11.7	
08/31/18	1605	Pump	33.41			20.1	9.11	3664	0.55	>1100		-10.6	SURGE W/ PUMP
08/31/18	1610	Pump	33.51			20.4	9.07	3637	0.53	>1100		-3.5	
08/31/18	1615	Pump	33.74			20.5	9.27	3567	0.63	>1100		-4.5	SURGE W/ PUMP
08/31/18	1620	Pump	33.52			20.6	9.55	3563	0.66	>1100		-4.8	
08/31/18	1625	Pump	33.98	↓	↓	20.2	9.40	3588	0.63	>1100		-3.4	SURGE W/ PUMP
08/31/18	1630	Pump	35.09	36.0	0.3	20.1	9.43	3600	0.65	>1100		-1.7	STOP PUMP TO BAIL
08/31/18	1635	BAIL		↓	1								1 WELL VOLUME
08/31/18	1640	BAIL											
08/31/18	1645	PUMP	35.60	↓	0.36	20.2	10.18	3518	0.95	>1100		22.0	RESUME PUMPING

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

00916234
00191262

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW47
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
08/31/18	1650	Pump	35.67	~~35~~ 9m	0.36	20.4	10.18	3577	0.91	>1100		17.9	STOP PUMPING, WILL RETURN
09/07/18	0655	Pump	27.81			19.2	9.61	3620	0.21	362		123.5	
09/07/18	0700	Pump	28.68			19.3	9.65	3607	0.16	>1100		115.3	SURGE w/ PUMP
09/07/18	0705	Pump	29.55			19.3	9.67	3582	0.18	975		101.8	
09/07/18	0710	Pump	29.99			19.6	9.94	3586	0.32	368		89.7	SURGE w/ PUMP
09/07/18	0715	Pump	30.02			19.9	9.99	3579	0.39	361		80.0	
09/07/18	0720	Pump	30.26			19.5	9.97	3575	0.47	331		73.1	SURGE w/ PUMP
09/07/18	0725	Pump	30.90	↓	↓	19.6	9.75	3609	0.52	448		68.4	
09/07/18	0730	Pump	31.42	55.0	0.36	19.4	9.52	3685	0.60	281		65.1	
09/07/18	0735	Pump	31.20		0.32	19.7	9.41	3715	0.60	920		63.4	SURGE w/ PUMP
09/07/18	0740	Pump	31.43		↓	19.4	9.25	3736	0.61	935		61.2	
09/07/18	0745	BAIL											2 WELL VOLUMES
09/07/18	0750	BAIL											
09/07/18	0755	Pump	30.73		0.32	19.2	10.10	3629	1.11	1020		66.8	
09/07/18	0800	Pump	31.25			19.5	9.71	3707	0.93	>1100		63.8	
09/07/18	0805	Pump	31.51			19.6	9.57	3755	0.86	>1100		61.9	
09/07/18	0810	Pump	31.65			19.6	9.33	3881	0.93	>1100		60.3	
09/07/18	0815	Pump	31.72			19.5	9.19	3928	0.63	1010		59.9	SURGE w/ PUMP
09/07/18	0820	Pump	32.69			19.5	8.57	4105	0.48	>1100		61.2	
09/07/18	0825	Pump	32.15	↓	↓	19.4	8.21	4117	0.43	413		63.7	SURGE w/ PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW47
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/07/18	0830	Pump	32.53	↓	↓	19.3	8.01	4141	0.43	390		65.2	
09/07/18	0835	Pump	32.95	73.0	0.32	19.6	7.76	4174	0.39	416		66.8	SURGE W/ PUMP
09/07/18	0840	Pump	32.03	|	0.26	19.6	7.54	4237	0.34	440		68.5	
09/07/18	0845	Pump	32.32	|	|	19.3	7.44	4221	0.32	465		70.5	
09/07/18	0850	Pump	32.74	|	|	19.4	7.46	4213	0.34	371		70.3	
09/07/18	0855	Pump	32.96	|	|	19.3	7.37	4244	0.30	347		71.0	
09/07/18	0900	Pump	33.20	|	|	19.5	7.30	4275	0.24	356		71.9	SURGE W/ PUMP
09/07/18	0905	Pump	33.89	|	|	19.5	7.29	4272	0.22	517		71.7	
09/07/18	0910	Pump	34.37	|	|	19.7	7.30	4242	0.27	536		70.1	
09/07/18	0915	Pump	33.67	|	|	19.6	7.83	4081	0.48	229		60.6	
09/07/18	0920	Pump	33.70	|	|	19.7	7.88	4099	0.47	196		59.4	SURGE W/ PUMP
09/07/18	0925	Pump	33.77	|	|	19.7	7.58	4170	0.38	636		59.3	
09/07/18	0930	Pump	34.26	|	|	19.5	7.41	4174	0.36	277		60.4	SURGE W/ PUMP
09/07/18	0935	Pump	34.21	|	|	20.6	7.33	424	0.32	176		59.3	
09/07/18	0940	Pump	34.80	↓	↓	19.5	7.32	4226	0.29	182		57.9	3 WELL VOLUMES
09/07/18	0945	Pump	35.00	91.0	0.26	19.5	7.35	4233	0.32	146		54.8	STOP PUMP TO BAIL
09/07/18	0950	Bail		|	|							
09/07/18	0955	Bail		|	|							
09/07/18	1000	—		|	|							PUMP BROKE, SWITCH TO NEW PUMP
09/07/18	1005	—		↓	|								↓

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW47
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
09/07/18	1010	—		↓									↓
09/07/18	1015	—											↓
09/07/18	1020	Pump	29.34		0.33	19.5	8.25	4100	0.75	236		99.3	RESUME PUMPING
09/07/18	1025	Pump	30.58		↓	19.5	8.11	4130	0.67	227		98.0	
09/07/18	1030	Pump	31.30			19.5	7.80	4199	0.64	222		96.0	SURGE W/ PUMP
09/07/18	1035	Pump	32.00			19.7	7.59	4253	0.46	330		93.4	
09/07/18	1040	Pump	32.54			19.7	7.52	4264	0.42	277		90.3	SURGE W/ PUMP
09/07/18	1045	Pump	35.55			19.6	7.62	4256	0.46	365		87.1	
09/07/18	1050	Pump	34.06			19.7	7.61	4247	0.47	287		84.5	SURGE W/ PUMP
09/07/18	1055	Pump	35.00			19.6	7.58	4219	0.48	206		82.2	
09/07/18	1100	Pump	35.49			19.6	7.54	4229	0.49	173		81.2	SURGE W/ PUMP
09/07/18	1105	Pump	35.50	↓	↓	19.4	7.54	4217	0.49	165		80.2	
09/07/18	1110	Pump	35.35	110.0	0.33	19.8	7.54	4210	0.51	128		79.1	SURGE W/ PUMP
09/07/18	1115	Pump	35.50	↓	0.30	19.6	7.55	4200	0.53	120		78.4	
09/07/18	1120	Pump	35.62		↓	19.7	7.45	4222	0.47	82.4		78.2	
09/07/18	1125	Pump	35.85			19.8	7.35	4268	0.40	58.5		78.8	SURGE W/ PUMP
09/07/18	1130	Pump	35.89			19.6	7.32	4325	0.35	85.5		79.0	
09/07/18	1135	Pump	35.88			19.8	7.26	4302	0.32	63.4		79.0	
09/07/18	1140	Pump	35.85			19.8	7.26	4320	0.32	57.7		78.1	
09/07/18	1145	Pump	35.83	↓	↓	19.9	7.22	4329	0.28	48.9		75.2	

Development Criteria: 1) sediment <0.75 mL/L. 2) turbidity within 10 NTU range for 30 minutes. 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW47
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979/6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/07/18	1150	Pump	35.84			19.9	7.21	4332	0.26	40.5		74.7	SURGE W/ PUMP
09/07/18	1155	Pump	35.83			19.6	7.17	4397	0.23	82.0		73.0	
09/07/18	1200	Pump	35.31			20.1	7.17	4347	0.22	42.8		70.8	
09/07/18	1205	Pump	35.59			19.9	7.15	4383	0.19	34.9		68.8	
09/07/18	1210	Pump	35.64	128.0	0.3	19.9	7.15	4382	0.18	30.9		68.6	SURGE W/ PUMP
09/07/18	1215	Pump	35.71		0.23	19.9	7.14	4371	0.17	61.7		67.3	
09/07/18	1220	Pump	35.64			19.6	7.13	4375	0.16	47.8		66.8	
09/07/18	1225	Pump	35.50			20.1	7.13	4396	0.16	35.4		65.6	
09/07/18	1230	Pump	35.66			20.2	7.12	4417	0.15	26.1		64.0	
09/07/18	1235	Pump	35.58			20.2	7.11	4411	0.14	24.7		63.1	
09/07/18	1240	Pump	35.47			20.0	7.11	4411	0.13	19.5		62.8	SURGE W/ PUMP
09/07/18	1245	Pump	35.35			20.0	7.10	4424	0.13	56.2		63.1	
09/07/18	1250	Pump	35.28			20.0	7.10	4406	0.13	43.1		62.8	
09/07/18	1255	Pump	35.39			19.9	7.10	4430	0.12	31.4		62.8	
09/07/18	1300	Pump	35.35			19.7	7.09	4432	0.11	27.8		63.1	
09/07/18	1305	Pump	35.67			19.8	7.09	4431	0.11	22.5		63.2	
09/07/18	1310	Pump	35.81			19.8	7.09	4434	0.11	18.2		63.2	SURGE W/ PUMP
09/07/18	1315	Pump	35.95			19.6	7.09	4429	0.11	64.1		63.2	
09/07/18	1320	Pump	36.23			19.8	7.09	4432	0.11	28.0		62.0	SURGE W/ PUMP
09/07/18	1325	Pump	36.30			20.5	7.10	4440	0.15	21.0		61.0	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: 47WW47
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
09/07/18	1330	Pump	35.55	146.0	0.23	20.2	7.10	4435	0.13	18.2		60.8	
09/07/18	1335	Pump	35.45	↓	↓	20.1	7.09	4430	0.12	12.9		60.5	
09/07/18	1340	Pump	35.51			20.2	7.09	4429	0.12	12.7		60.5	
09/07/18	1345	Pump	35.54			20.1	7.08	4435	0.11	9.54		60.8	
09/07/18	1350	Pump	35.46			20.2	7.07	4444	0.11	8.62		60.6	
09/07/18	1355	Pump	35.49			20.4	7.07	4448	0.11	13.8		59.7	
09/07/18	1400	Pump	35.51			20.3	7.07	4447	0.08	16.9		56.7	
09/07/18	1405	Pump	35.18	↓		20.5	7.06	4449	0.08	17.4		55.1	
09/07/18	1410	Pump	34.80	160.0	↓	21.1	7.07	4454	0.08	18.1		54.0	~3 DRUMS FULL

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW41	Date: 7/10/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116	Recorded By: WTR Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: YSI 4676 TURB 62E2		Water Level Indicator Type/ID #: Geotech #5886
	Equipment Group:		Equipment Group:
	Development Equipment: Tornado Pump		Equipment Decon.: ALCO / Bucket
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 27.10
	Total Well Depth (ft) [d]: 38.10	Water Column Thickness (ft) [d-c]: 11.0'	Well Volume (gal) ([d-c] x b): 0.6 gallons
	Ground Condition of Well: needs cleaning		Remarks:

CASING INFO											
Casing I.D. (in) [a]:		1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:		0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. ~~(mL/L)~~	~~Radiation~~ ORP	Remarks (odor, clarity, etc.)
7/10/18	1215	Pump	28.10	INT		20.6	6.88	2917	0.72	334		69.0	Began sed Removal
	1220	"	28.50	1.0	0.2	21.4	6.84	2913	0.40	>1100		21.5	
	1225	"	29.70	2.0	0.4	19.4	6.88	2905	0.34	946		-21.0	very slow recharge
	1230	"			0.4	20.0	6.94	2891	0.33	429		-34.2	
	1235	"	31.70		0.4	20.4	6.87	2900	0.99	657		-30.7	
	1240	"	31.90			20.3	6.87	2897	0.73	572		-35.1	
	1245		32.00			20.9	6.87	2897	0.86	503		-34.0	
	1250		33.25			19.9	6.86	2951	1.11	1040		-64.5	
	1255		33.50			20.2	6.85	2879	1.63	>1100		-57.0	
	1300		35.00			19.4	6.88	2880	3.34	307		-38.1	shut off pump / Let Recharge
	1330		28.5			19.7	6.83	2865	2.87	916		19.1	+ 29.50 ≈ 12 gallons
	1405												Let recharge to 28.10 then Bail / Surge

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW41
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07-15-18	0915	Pump	27.20			18.9	6.67	3805	4.07	33.7		115.6	INT
07/15/18	0920	Pump	31.55			19.2	6.70	3006	2.45	20.0		115.3	
07/15/18	0925	Pump	31.90			19.8	6.73	3015	2.55	17.9		110.9	
07/15/18	0930	Pump	33.80			19.4	6.74	3006	2.54	35.0		100.9	
07/15/18	0935	Pump	34.50			19.5	6.76	3009	3.36	22.6		94.3	
07/15/18	0940	Pump	34.05			21.0	6.77	3005	3.02	19.9		92.8	
07/15/18	0945	Pump	33.80			20.9	6.77	3013	2.78	18.2		88.8	
07/15/18	0950	Pump	33.45			20.6	6.77	3011	3.00	11.8		84.6	
07/15/18	0955	Pump	33.30			20.5	6.78	3011	3.44	5.08		81.7	
07/15/18	1000	Pump	33.15			20.4	6.78	3009	3.69	3.01		80.3	
07/15/18	1005	Pump	33.15			20.3	6.78	3010	3.77	1.24		79.8	
07/15/18	1010	Pump	33.10			20.5	6.77	3009	3.67	0.02		79.2	
07/15/18	1015	Pump	32.80			20.5	6.77	3010	3.65	0.02		78.4	
07/15/18	1020	Pump	32.75			20.5	6.77	3009	3.63	0.02		78.2	
07/15/18	1025	Pump	32.70			20.3	6.77	3010	3.63	0.02		77.8	
07/15/18	1030	Pump	32.65			20.4	6.77	3011	3.63	0.02		77.8	65 GALLONS, 1 DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW 41
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. ~~(mg/L)~~	Radiation CKP	Remarks (odor, clarity, etc.)
7/10/18	1405	Pump	30.0	2.0	0.5	20.4	6.78	2883	3.61	7100		34.6	
	1410	Pump	32.05			20.5	6.77	2866	7.83	997		38.1	
	1415	Pump	33.80			19.3	6.78	2875	3.56	981		37.6	
7/10/18	1420		35.6										STOP Purge for Day
07/13/18	1300	Pump	27.15	0.65	0.13	22.2	7.32	2894	2.69	626		92.2	INT.
07/13/18	1305	Pump	28.90			20.2	7.10	2860	2.22	882		-27.9	SURGE W/ PUMP
07/13/18	1310	Pump	29.45			20.6	7.04	2848	2.15	435		-25.5	
07/13/18	1315	Pump	29.75			20.7	7.02	2849	2.17	173		2.0	
07/13/18	1320	Pump	29.90			20.7	7.00	2849	2.13	156		-0.3	
07/13/18	1325	Pump	30.05	0.65	0.13	20.6	6.98	2847	2.02	62.4		26.2	
07/13/18	1330	Pump	31.25	1.70	0.34	20.4	6.96	2841	2.27	34.8		42.0	
07/13/18	1335	Pump	32.10			20.7	7.01	2841	2.51	27.1		37.9	
07/13/18	1340	Pump	32.70			20.8	7.06	2842	2.60	28.8		29.4	
07/13/18	1345	Pump	33.15			20.3	7.07	2836	2.77	26.4		23.5	
07/13/18	1350	Pump	33.55			20.4	7.04	2835	3.19	24.0		24.7	SURGE W/ PUMP
07/13/18	1355	Pump	34.20			19.6	7.02	2790	2.78	439		-25.2	
07/13/18	1400	Pump	36.45	1.70	0.34								STOP PUMP TO LET RECHARGE
07/14/18	0920	Pump	30.10	2.5	0.5	19.0	6.70	2926	4.27	43.8		107.3	INT
07/14/18	0925	Pump	33.00			19.2	6.73	2928	3.38	58.8		100.8	
07/14/18	0930		35.50										STOP PUMP FOR RECHARGE, WILL RETURN

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW42R	Date: 07/04/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 100797916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M 4076		Water Level Indicator Type/ID #: GEOTECH #6162
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP		Equipment Decon.: ALCONOX/BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 27.93
	Total Well Depth (ft) [d]: 41.95	Water Column Thickness (ft) [d-c]: 14.02	Well Volume (gal) ([d-c] x b): 21.3 GALLONS
	Ground Condition of Well:		Remarks: TOS = 32 FT

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/04/2018	1400	Pump	27.93			22.8	6.83	3541	0.37	>1100		113.3	
07/04/2018	1405	Pump	29.15			21.5	6.61	3561	0.24	170		113.3	SURGE WELL BOTTOM W/ PUMP
07/04/2018	1410	Pump	29.40			20.8	6.59	3353	0.28	>1100		113.3	
07/04/2018	1415	Pump	30.70			20.7	6.59	3429	0.36	481		112.8	BACKWASH W/ PUMP
07/04/2018	1420	Pump	31.30			20.8	6.57	3411	0.42	212		112.1	
07/04/2018	1425	Pump	30.51			20.8	6.60	3497	0.37	103		111.9	
07/04/2018	1430	Bail	30.60										BAIL SEDIMENT OUT
07/04/2018	1435	Bail											" "
07/04/2018	1440	Bail											" "
07/04/2018	1445	Bail	28.60										STOP BAILING, START PUMP
07/04/2018	1450	Pump	30.05			21.0	6.68	3333	0.88	>1100		111.9	
07/04/2018	1455	Pump	30.52			20.8	6.59	3469	0.48	>1100		112.8	SURGE W/ PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW42R
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/04/2018	1500	Pump	30.63	5.0	1.0	20.8	6.55	3500	0.29	822		112.2	
07/04/2018	1505	Pump	30.61	5.0	1.0	20.8	6.55	3519	0.26	398		112.0	
07/04/2018	1510	Pump	30.60	5.0	1.0	20.9	6.55	3525	0.20	300		109.9	
07/04/2018	1515	Bail											Bail out Sediment
07/04/2018	1520	Bail											
07/04/2018	1525	Bail	28.50										Stop bailing, start pumping
07/04/2018	1530	Pump	30.30	5.0	1.0	21.1	6.62	3479	0.37	>1100		108.2	
07/04/2018	1535	Pump	30.45	5.0	1.0	21.0	6.57	3511	0.27	>1100		108.8	
07/04/2018	1540	Pump	30.50	5.0	1.0	20.8	6.55	3547	0.19	409		107.8	
07/04/2018	1545	Pump	30.65	5.0	1.0	20.9	6.55	3550	0.17	265		106.6	Surge w Pump
07/04/2018	1550	Pump	30.69	5.0	1.0	20.9	6.50	3465	0.09	502		104.4	
07/04/2018	1555	Bail											Bail out Sediment
07/04/2018	1560	Bail											" "
07/04/18	1565	Bail	~~28.60~~										~~Stop Bail, start Pump~~
07/04/18	1600	Pump	28.60										Stop Bail, start Pump
07/04/18	1605	Pump	28.61	5.0	1.0	21.7	6.69	3506	0.58	>1100		103.1	
07/04/18	1610	Pump	29.70	5.0	1.0	21.5	6.62	3502	0.37	>1100		104.6	
07/04/18	1615	Pump	29.90	5.0	1.0	21.2	6.55	3540	0.24	>1100		104.2	
07/04/18	1620	Pump	30.25	5.0	1.0	20.9	6.57	3591	0.27	>1100		104.7	
07/04/18	1625	Pump	30.90	5.0	1.0	21.0	6.51	3547	0.27	916		102.1	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW42R
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation (ORP)	Remarks (odor, clarity, etc.)
07/04/18	1630	Pump	30.00	5.0	1.0	20.7	6.58	3602	0.23	345		102.3	
07/04/18	1635	Pump	30.30	5.0	1.0	20.9	6.51	3586	0.19	208		102.1	
07/04/18	1640	Bail											TURN OFF PUMP TO BAIL
07/04/18	1645	Bail											
07/04/18	1650	Pump	28.90	5.0	1.0	21.0	6.60	3527	0.52	>400		102.1	
07/04/18	1655	Pump	31.70	5.0	1.0	20.6	6.55	3693	0.29	631		102.8	STOP FOR DAY, COME BACK TOMORROW 1/3 BELOW
07/04/18													
07/05/18	0900	"	28.00										
07/05/18	0905												INT.
07/05/18	0910	Pump	30.89			20.5	6.90	2867	0.75	15.9		46.0	SETTING UP PUMP
07/05/18	0916	Pump	30.25			20.7	6.77	2942	0.24	171		44.4	SURGE W/ PUMP
07/05/18	0920	Pump	30.82			20.6	6.69	2936	0.11	106		29.1	
07/05/18	0925	Pump	30.90			20.6	6.70	2939	0.11	139		30.2	STOP PUMP TO BAIL SED.
07/05/18	0930	Bail											BAIL SEDIMENT
07/05/18	0935	Bail											BAIL SEDIMENT
07/05/18	0940	~~Bail~~ Pump	28.55			21.1	6.92	2890	1.05	600		52.4	START PUMP AGAIN
07/05/18	0945	Pump	30.73			20.9	6.64	2873	0.48	400		35.1	
07/05/18	0950	Pump	30.13			20.8	6.67	2953	0.67	214		47.5	SURGE W/ PUMP
07/05/18	0955	Pump	30.00			20.9	6.66	2939	0.73	155		44.6	
07/05/18	1000	Pump	31.27			20.6	6.66	2954	0.70	87.1		40.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW42R
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/05/18	1005	Pump	29.70			21.2	6.63	2960	0.58	46.6		34.9	
07/05/18	1010	Pump	30.18			20.8	6.63	2980	0.51	36.9		34.6	
07/05/18	1015	Pump	30.29			20.8	6.64	2966	0.43	25.6		29.8	
07/05/18	1020	Pump	30.27			20.9	6.65	2948	0.40	23.0		28.9	
07/05/18	1025	Pump	30.27			20.8	6.65	2957	0.35	8.88		27.8	
07/05/18	1030	Pump	30.28			20.8	6.64	2955	0.32	3.36		25.4	
07/05/18	1035	Pump	30.27			20.8	6.65	2965	0.29	0.02		23.7	
07/05/18	1040	Pump	30.27			20.9	6.65	2944	0.26	0.02		19.9	
07/05/18	1045	Pump	30.25			21.0	6.65	2944	0.23	0.02		15.9	
07/05/18	1050	Pump	30.23			20.9	6.66	2967	0.05	0.02		13.3	
07/05/18	1055	Pump	30.25			20.9	6.68	2942	0.06	0.02		10.6	
07/05/18	1100	Pump	30.26			21.0	6.69	2943	0.05	0.02		8.1	3¼ Drums

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW43R	Date: 6/26/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: TP Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: Solinst		Water Level Indicator Type/ID #: GEOTECH #6162
	Equipment Group:		Equipment Group:
	Development Equipment: Tornado pump		Equipment Decon.: Bucket Alconox
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 26.22
	Total Well Depth (ft) [d]: 34 BGS 37 TOC	Water Column Thickness (ft) [d-c]: 10.78	Well Volume (gal) [(d-c) x b]:
	Ground Condition of Well:		Remarks: SOP CALCULATOR = 33 gallons per 1 well volume

CASING INFO										
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	(4.0)	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	~~Sed.~~ (mL/L) ORP	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
6/26/18	1320	Pump	26.22	INT	0.4	19.4	6.67	2786	1.57	15.5		154.6	Cloudy
1325	1340	Bailer		9.1								>	Remove SED From Bottom
6/26	1414	Pump	27.31	2.5	0.5	19.9	6.76	2612	1.49	OR		63.3	
6/26	1419	"	27.49	2.5	0.5	19.7	6.78	2751	1.74	745		52.1	
6/26	1427	"	27.56	2.5	0.5	19.3	6.78	2758	2.23	359		47.3	Orange
6/26	1432		27.69	2.5	0.5	19.2	6.79	2749	1.20	728		43.1	
6/26	1443		27.48	2.5	0.5	19.2	6.80	2754	0.75	>1100		40.1	
6/26	1448		27.65	2.5	0.5	19.1	6.80	2753	0.61	>1100		33.6	
6/26	1453		27.69	2.5	0.5	19.2	6.81	2748	0.43	>1100		29.4	
6/26	1503		27.59	2.5	0.5	19.1	6.84	2756	2.00	949		27.5	
6/26	1508		27.70	2.5	0.5	19.0	6.84	2762	0.50	575		24.8	
6/26	1530	↓	27.55	2.5	0.5	19.8	6.84	2724	3.55	>1100		52.0	Surged

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW43R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
6/26/18	1535	Pump	27.40	2.5	0.5	19.7	6.84	2743	2.55	430		51.1	Orange
6/26	1547	Pump	27.5	2.5	0.5	19.5	6.84	2752	2.00	771		53.8	
6/26	1552	"	27.52	2.5	0.5	19.3	6.83	2749	1.53	>1000		52.8	very
6/26	1601	"	27.50	2.5	0.5	19.2	6.81	2750	3.70	>1000		53.5	Lt orange
6/26	1606	"	27.60	2.5	0.5	19.3	6.83	2758	0.88	>1000		50.9	
6/26	1615	"	27.63	2.5	0.5	19.0	6.85	2755	0.58	>1000		48.4	
6/26	1620	"	28.71	2.5	0.5	19.0	6.84	2754	0.86	572		47.3	Rate is ~~2.75~~ 0.55 2.75 m5 17.5
6/26	1628	"	27.61	2.75	0.55	19.0	6.87	2750	0.44	515		45.1	
6/26	1633	"	26.99	2.75	0.55	20.2	6.90	2670	2.20	521		43.6	68 gallons in drum 5.5
6/27/18	0755	"	27.32	3.3	0.66	19.6	6.97	2778	2.68	>1000		157.5	Surged
6/27	0800	"	27.55	3.3	0.66	19.6	6.81	2770		>1000		154.1	
6/27	0805	"	27.05	3.3	0.66	20.1	6.85	2776	1.17	—		149.1	- Surged pump
6/27	0810	"	27.50	3.3	0.66	19.7	6.84	2768	0.91	>1000		143.6	
6/27	0815	"	27.44	3.3	"	19.7	6.85	2767	0.82	1050		139.1	
6/27	0820	"	27.35	3.3	"	19.9	6.86	2760	—	—		133.1	Lower pump / Surge
6/27	0825	"	27.21	3.3	"	19.6	6.88	2784	0.90	684		130.0	
6/27	0830	"	27.20	3.3	"	20.1	6.88	2752	0.40	514		124.2	
6/27	0835	"	27.15	3.3		20.1	6.89	2752	0.40	394		121.1	Cloudy 60 25.4 84
6/27	0840	"	27.10	3.3	"	20.4	6.84	2754	6.37	464 357		115.9	cloudy
6/27	0845	"	27.05	3.3	"	20.3	6.90	2758	0.38	283		112.3	94

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW43R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP	Remarks (odor, clarity, etc.)
6/27/18	0850	Pump	27.07	3.3	0.66	20.4	6.90	2758	0.35	279		109.4	
6/27/18	0855	"	27.06	3.3	0.66	20.3	6.88	2760	0.41	245		106.9	
6/27/18	0900	"	27.06	3.3	0.66	20.4	6.90	2769	0.34	226		103.9	Moved pump to Bottom for 1
6/27	0905	"	28.05	3.3	0.66	19.9	6.85	2792	0.61	1020		105.0	2-Drums FULL
6/27	0910	"	27.21	3.3	0.66	20.4	6.88	2766	0.44	493		103.2	
6/27	0915	"	27.11	3.3	0.66	20.4	6.90	2768	0.46	379		100.8	
6/27	0920	"	27.07	"	"	20.5	6.91	2766	0.45	358		98.8	
6/27	0925	"	27.05	"	"	20.5	6.88	2767	—	306		97.7	
6/27	0930	"	27.08	"	"	20.5	6.91	2769	0.50	292		96.0	
6/27	0935	"	27.05	"	"	20.5	6.91	2768	0.39	260		94.6	
6/27	0940	"	27.09	"	"	20.4	6.91	2763	0.27	213		91.9	
6/27	0945	"	27.11	3.3	"	20.3	6.90	2764	0.26	181		89.4	
6/27	0955		27.12	3.3	"	20.4	6.90	2761	0.19	133		87.7	
6/27	1000		~~27.13~~	3.3	"	20.3	6.90	2762	0.21	105		86.5	
6/27	1005		27.12	3.3	"	20.5	6.90	2761	0.25	72.7		84.0	
6/27	1010		27.17	3.3	"	20.3	6.90	2764	0.15	61.2		83.1	
6/27	1015		27.22	"		20.3	6.90	2761	0.11	48.5		81.7	
6/27	1020		27.23	"		20.3	6.90	2763	0.10	39.5		80.6	
6/27	1025		27.23	"		20.2	6.90	2762	0.13	28.2		79.1	
6/27	1030		27.29	"		20.1	6.90	2763	0.15	20.6		78.9	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

69 gallons

(69 gallons in Drum)

00916249
00191262

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW43R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) CKP	Remarks (odor, clarity, etc.)
6/27/18	1035	Pump	27.27	2.5	0.5	20.1	6.90	2765	0.19	28.6		76.9	125 in Drums
6/27/18	1040		27.92	2.5	0.5	19.3	6.89	2775	0.43	41.8		76.2	
6/27/18	1045		28.42	2.5	0.5	19.2	6.88	2763	0.24	27.5		76.8	
6/27/18	1050		28.65	2.5	0.5	20.2	6.89	2764	0.22	28.8		74.5	
6/27/18	1055		27.09	2.5	0.5	21.3	6.92	2764	0.26	32.0		71.4	
6/27/18	1100		26.93	2.5	0.5	21.5	6.97	2770	0.31	42.2		69.9	
6/27/18	1105		26.85	2.5	0.5	21.6	6.97	2773	0.31	49.0		67.4	
6/27/18	1108		26.82	1.5	0.5	21.7	6.97	2778	0.33	58.7		67.2	3 min readings
6/27/18	1111		26.88	1.5	0.5	21.5	6.95	2780	0.36	66.4		67.0	
6/27/18	1114		26.83	1.5	0.5	21.4	6.93	2776	0.34	55.9		67.8	
6/27/18	1117		26.82	1.5	0.5	21.6	6.92	2777	0.34	57.0		67.7	
6/27/18	1120		26.81	1.5	0.5	21.6	6.93	2776	0.34	53.3		67.3	
													Complete Last Drum 2/3 FL21

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW44	Date: 07/07/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+4M4075		Water Level Indicator Type/ID #: GEOTECH #5886
	Equipment Group:		Equpment Group:
	Development Equipment: TORNADO Pump		Equipment Decon.: ALCONOX/BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 26.90
	Total Well Depth (ft) [d]: 39.05	Water Column Thickness (ft) [d-c]: 12.15	Well Volume (gal) {[d-c] x b}: 13.93
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/07/18	1330	Pump	26.90			21.7	7.50	3503	1.21	>1100		90.2	INT
07/07/18	1335	Pump	29.60			20.5	7.23	2509	0.08	>1100		-39.0	
07/07/18	1340	Pump	30.4			21.4	7.22	3517	0.66	557		-23.7	STOP PUMP FOR RECHARGE
07/07/18	1345	Pump	32.75			20.2	7.16	3463	0.23	>1100		-8.6	STOP PUMP FOR RECHARGE
07/07/18	1350	~~Pump~~	34.30										" "
07/07/18	1355	—	33.80										" "
07/07/18	1400	Pump	35.50			19.8	7.35	2973	0.21	>1100		18.3	RESUME PUMPING
07/07/18	1405	Pump	37.10			20.3	7.13	3460	0.86	>1100		10.3	STOP PUMP FOR RECHARGE
07/07/18	1415	.	36.90										VERY SLOW RECHARGE 0.1FT/10MIN
07/07/18	1420												WELL DEWATERED, LEAVE TO RECHARGE
07/08/18	0900		26.90										WELL RECHARGED OVERNIGHT, INT.
07/08/18	0905	Pump	27.10			20.4	7.31	3759	1.99	>1100		176.4	WORK PUMP @ BOTTOM TO REMOVE SED.

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW44
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/08/18	0910	Pump	29.20			20.6	7.13	3732	1.49	>1000		27.5	
07/08/18	0915	Pump	31.05			19.9	7.11	3724	1.40	389		33.0	
07/08/18	0920	Pump	32.40			20.1	7.09	3731	1.37	88.4		35.5	SURGE W/ PUMP
07/08/18	0925	Pump				20.1	7.06	3727	1.32	94.7		38.1	LEAVE TO ALLOW RECHARGE
			26.95										JM
07/09/18	0830	Pump	26.95	2.5	0.5	19.5	7.13	3848	1.03	97.9		91.0	INT.
07/09/18	0835	Pump	31.90	2.5	0.5	19.6	7.07	3843	0.83	72.3		80.6	
07/09/18	0840	Pump	36.15	2.5	0.5	19.5	7.05	3867	0.93	31.7		81.3	
07/09/18			37.45										SHUT OFF PUMP ALLOW RECHARGE, WILL RETURN LATER
07/09/18	1100	Pump	30.10	5.0	1.0	19.5	6.95	3834	2.84	10.3		-12.2	
07/09/18	1105	Pump	35.20	5.0	1.0	19.5	6.91	3834	2.18	13.9		-3.2	STOP PUMP TO RECHARGE OVERNIGHT
07/10/18	0825	BAIL	26.90										
07/10/18	0830	BAIL											
07/10/18	0835	Pump	30.84			19.4	7.24	3663	3.28	71100		-2.1	STOP BAILING, BEGIN PUMPING
07/10/18	0840	Pump	35.20			19.9	7.08	3665	2.56	71100		-5.6	
07/10/18	0845	Pump	35.47			20.2	7.05	3657	2.14	670		-6.9	
07/10/18	0850	Pump	35.90			20.3	7.05	3672	2.35	225		-1.9	
07/10/18	0855	Pump	39.10			19.8	7.03	3675	2.58	148		18.4	STOP PUMPING, LEAVE TO RECHARGE
	09												JM
7/10/18	1550	Pump	29.70			19.6	6.88	3686	2.44	12.4		77.2	2720 DTW

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW 44
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ OKP	Remarks (odor, clarity, etc.)
7/10/18	1555	Pump	32.60		0.5	19.6	6.87	3700	2.08	12.8		76.6	Clear
7/10/18	1600	Pump	35.90			19.6	6.89	3726	2.09	11.1		74.4	50 gallons total
7/13/18	1200	Pump	27.50			20.2	7.35	3664	0.94	16.7		111.2	
7/13/18	1205	Pump	27.85			20.2	7.20	3669	0.69	3.09		98.1	1 Drum
7/13/18	1210	Pump	29.85			20.2	7.14	3663	0.73	3.06		96.4	
7/13/18	1215	Pump	30.70			20.6	7.10	3665	0.62	3.40		88.2	
7/13/18	1220	Pump	30.95			20.6	7.11	3662	0.60	3.20		96.2	
7/13/18	1225	Pump	31.45			21.1	7.06	3663	0.61	5.07		33.6	
7/13/18	1230	Pump	31.70			21.1	7.05	3660	0.59	3.84		31.2	
7/13/18	1235	Pump	31.90			21.5	7.05	3659	0.60	3.56		24.1	80 GALLONS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW45	Date: 07/09/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 1009916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: YSI JM PRO+ 4M4075		Water Level Indicator Type/ID #: GEOTECH #6162
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP		Equipment Decon.: ALCONOX / BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 27.50
	Total Well Depth (ft) [d]: 39.35	Water Column Thickness (ft) [d-c]: 11.85'	Well Volume (gal) ([d-c] x b): 18.55
	Ground Condition of Well:		Remarks:

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/09/18	1405	Pump	28.20	2.5	0.5	22.0	8.03	3532	3.33	>1100		110.7	
07/09/18	1410	Pump	29.00	2.5	0.5	18.9	7.89	3490	2.26	>1100		23.3	
07/09/18	1415	Pump	28.90	2.0	0.4	19.1	7.73	3505	1.98	158		3.0	Surge w/ Pump
07/09/18	1420	Pump	28.80	2.0	0.4	19.1	7.65	3518	1.56	896		-1.6	
07/09/18	1425	Pump	28.70	2.0	0.4	19.1	7.50	3556	1.04	223		22.3	
07/09/18	1430	Pump	28.80	2.0	0.4	19.1	7.44	3550	1.07	105		2.5	
07/09/18	1435	Pump	28.80	2.0	0.4	19.1	7.36	3568	0.96	82.3		25.4	
07/09/18	1440	Pump	28.75	2.0	0.4	19.3	7.30	3607	0.72	137		59.5	
07/09/18	1445	Pump	28.80	2.0	0.4	18.8	7.31	3573	0.82	197		41.2	
07/09/18	1450	Pump	28.80	2.0	0.4	18.9	7.29	3578	0.69	123		32.2	
07/09/18	1455	Pump	28.81	2.0	0.4	18.9	7.26	3613	0.48	64.2		26.6	STOP PUMP TO BAIL
07/09/18	1500	BAIL											

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/09/18	1505	BAIL											
07/09/18	1510	BAIL	28.90	2.0	0.4	19.2	7.25	3603	0.90	267		84.5	STOP BAILING RESUME PUMPING
07/09/18	1515	Pump	28.80	2.0	0.4	19.0	7.12	3598	0.78	311		62.7	
07/09/18	1520	Pump	28.85	2.0	0.4	18.9	7.11	3649	0.41	109		46.8	
07/09/18	1525	Pump	28.80	2.0	0.4	19.2	7.11	3622	0.51	103		69.1	
07/09/18	1530	Pump	28.85	2.0	0.4	18.9	7.10	3655	0.38	81.6		44.9	
07/09/18	1535	Pump	28.90	2.0	0.4	19.0	7.00	3672	0.30	53.0		40.1	
07/09/18	1540	Pump	28.85	2.0	0.4	18.9	7.09	3662	0.27	43.0		35.5	
07/09/18	1545	Pump	28.87	2.0	0.4	18.9	7.09	3659	0.25	40.0		32.2	
07/09/18	1550	Pump	28.90	2.0	0.4	18.9	7.08	3660	0.25	40.0		28.9	
~~07/09/18~~	~~1600~~	~~Pump~~	JM			18.9							JM
07/09/18	1555	Pump	28.90	2.0	0.4	18.9	7.08	3658	0.23	30.7		25.6	
07/09/18	1600	Pump	28.90	2.0	0.4	19.0	7.08	3655	0.21	29.7		22.4	STOP PUMPING TO BAIL SED.
07/09/18	1605	BAIL											
07/09/18	1610	BAIL	28.85	2.0	0.4	19.5	7.19	3605	0.68	144		86.7	STOP BAILING, RESUME PUMPING
07/09/18	1615	Pump	28.80	2.0	0.4	19.1	7.07	3615	0.46	88.0		67.9	
07/09/18	1620	Pump	28.82	2.0	0.4	19.0	7.06	3674	0.34	61.7		55.5	
07/09/18	1625	Pump	28.85	2.0	0.4	18.9	7.06	3672	0.26	47.0		44.3	
07/09/18	1630	Pump	28.87	2.0	0.4	19.0	7.06	3663	0.25	43.3		40.7	
07/09/18	1635	Pump	28.90	2.0	0.4	18.9	7.06	3663	0.24	36.7		36.2	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) ORP	Remarks (odor, clarity, etc.)
07/10/18	0915	Pump	27.55	2.0	0.4	18.7	7.37	3407	1.50	344		36.6	INT
07/10/18	0920	Pump	28.70	↓	↓	18.6	7.21	3400	0.57	123		29.5	
07/10/18	0925	Pump	29.00			18.5	7.20	3406	0.36	50.7		41.7	
07/10/18	0930	Pump	28.80			18.6	7.18	3454	0.21	21.9		44.1	
07/10/18	0935	Pump	28.84			18.6	7.18	3470	0.17	8.34		43.7	
07/10/18	0940	Pump	28.90			18.6	7.17	3475	0.14	4.57		43.7	STOP PUMPING, BEGIN BAILING
07/10/18	0945	BAIL											
07/10/18	0950	BAIL	29.10	2.0	0.4	18.6	7.39	3407	0.51	192		101.0	STOP BAILING, RESUME PUMPING
07/10/18	0955	Pump	29.00	↓	↓	18.7	7.23	3409	0.46	162		92.6	
07/10/18	1000	Pump	29.10			18.8	7.18	3459	0.34	89.3		79.4	
07/10/18	1005	Pump	28.80			18.9	7.18	3468	0.30	69.1		72.4	
07/10/18	1010	Pump	29.00			18.7	7.18	3461	0.26	44.0		68.2	
07/10/18	1015	Pump	28.80			18.8	7.18	3459	0.25	40.0		64.5	SURGE W/ PUMP
07/10/18	1020	Pump	28.84			19.0	7.18	3418	0.30	226		87.1	
07/10/18	1025	Pump	28.90			18.8	7.18	3418	0.27	94.1		65.3	
07/10/18	1030	Pump	29.00			18.7	7.18	3451	0.21	43.2		60.4	
07/10/18	1035	Pump	28.80			18.8	7.18	3458	0.17	34.5		56.9	SURGE W/ PUMP
07/10/18	1040	Pump	28.90			19.0	7.18	3438	0.14	34.2		100.1	
07/10/18	1045	Pump	28.80			18.7	7.18	3430	0.14	31.4		57.4	
07/10/18	1050	Pump	28.80	↓	↓	18.8	7.18	3456	0.13	22.8		51.0	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW45
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/10/18	1055	Pump	28.80	2.0	0.4	18.9	7.18	3465	0.12	12.5		46.5	
07/10/18	1100	Pump	28.80	2.0	0.4	18.8	7.18	3462	0.10	6.11		43.3	STOP PUMP TO BAIL
07/10/18	1105	BAIL											
07/10/18	1110	BAIL	29.50	2.0	0.4	18.6	7.33	3431	0.25	47.1		92.9	STOP BAILING, RESUME PUMPING
07/10/18	1115	Pump	29.60			18.5	7.20	3410	0.50	98.3		75.4	
07/10/18	1120	Pump	29.58			18.6	7.20	3451	0.79	69.4		65.7	
07/10/18	1125	Pump	29.55			18.6	7.20	3458	0.55	40.0		58.2	
07/10/18	1130	Pump	29.60			18.5	7.19	3455	0.34	20.4		62.7	
07/10/18	1135	Pump	29.00			19.0	7.19	3456	0.25	13.2		45.9	
07/10/18	1140	Pump	28.80			18.9	7.19	3454	0.23	8.31		43.2	
07/10/18	1145	Pump	28.80			18.8	7.19	3454	0.15	2.08		38.4	
07/10/18	1150	Pump	28.74			18.8	7.19	3453	0.13	0.02		36.2	
07/10/18	1155	Pump	28.72			19.0	7.18	3454	0.11	0.02		34.1	
07/10/18	1200	Pump	28.64			18.9	7.18	3453	0.11	0.62		31.7	
07/10/18	1205	Pump	28.60			19.0	7.18	3437	0.09	0.02		30.1	
07/10/18	1210	Pump	28.60			18.9	7.18	3444	0.09	0.02		28.0	
07/10/18	1215	Pump	28.60			19.0	7.18	3449	0.09	0.02		26.8	
07/10/18	1220	Pump	28.60	✓	✓	19.0	7.18	3440	0.09	0.02		23.4	STOP PUMPING 2 DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW46R	Date: 6/29/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: CTR Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: YSI / Eurotech Turbs Meter	Water Level Indicator Type/ID #: Geotech #6162	
	Equipment Group:	Equipment Group:	
	Development Equipment: Tornado/control Box	Equipment Decon.: Alco with Bucket	
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 27.51
	Total Well Depth (ft) [d]: 40.55 * should be 43	Water Column Thickness (ft) [d-c]: 13.04	Well Volume (gal) ([d-c] x b): 20 per SOP
	Ground Condition of Well: Cleared	Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ~~ORP~~	Remarks (odor, clarity, etc.)
6/29/18	1210	Pump	25.70	start	INT	21.1	6.72	856	0.48	71100		-13.5	SURGE WITH BAILER - Better
	1230	Pmp	28.65	2.5	0.5	20.9	6.78	930	1.18	71100		-81.8	ODOR
	1235	"	28.70	2.5	0.5	21.0	6.81	969	0.18	>1100		-88.3	
	1240	"	28.64	2.5	0.5	21.0	6.81	981	0.13	657		-88.8	
	1245	"	28.65	2.5	0.5	20.8	6.81	986	0.12	—		-91.6	Surge Block 10min
	1250	"	28.75	2.5	0.5	21.1	6.76	987	0.10	>1100		-70.5	clear 27.66
	1310	"	29.2	2.5	0.5	21.0	6.78	949	0.09	>1100		-75.4	
	1315		28.7	2.5	0.5	21.6	6.78	945	0.09	>1100		-77.0	New pump
	1320		28.92	2.0	0.4	21.5	6.76	882	0.09	342		-76.8	
	1325		28.46	2.0	0.4	21.5	6.81	997	0.07	97.4		-83.9	
	1330		28.40	2.0	0.4	21.4	6.81	954	0.07	187		-84.2	Orange
	1335		28.90	2.5	0.5	20.9	6.79	909	0.08	743		-81.8	≈3.79gal

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW46R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ (cpm)	Remarks (odor, clarity, etc.)
6/29/18	1340	Pump	29.20	2.0	0.4	21.0	6.79	931	0.07	1010		-80.8	
6/29/18	1345	Pump	28.75	2.0	0.4	20.9	6.82	948	0.07	>1100		-82.5	
6/29/18	1350	Pump	28.60	2.0	0.4	20.0	6.89	1409	0.07	170		-87.2	surged pump
6/29/18	1355	Pump	28.70	2.0	0.4	20.8	6.89	1177	0.06	755		-91.8	
6/29/18	1400	Pump	28.62	2.0	0.4	21.3	6.87	875	0.08	882		-85.7	Surge pump
6/29/18	1405	Pump	28.73	2.0	0.4	20.8	6.86	899	0.07	>1100		-86.9	STOP Pump & Surge Baller
6/29/18	1420	P	28.75	2.0	0.4	21.0	6.81	955	0.08	>1100		-69.1	27.60 ww
6/29/18	1425	P	28.85	2.0	0.4	21.0	6.78	898	0.11	>1100		-69.4	
6/29/18	1430	P	28.73	2.0	0.4	21.2	6.81	902	0.11	>1100		-74.3	.
6/29/18	1435	P	28.72	2.0	0.4	21.2	6.80	794	0.19	816		-74.4	Start surge with Baller 55 gal
6/29/18	1500	P	29.05			21.9	6.79	791	0.18	787		-58.2	
6/29/18	1505	P	28.13	2.0	0.4	22.1	6.81	752	0.22	>1100		-64.5	
7/2/18	0820	Pump	28.70		0.5	20.7	6.81	1008	0.94	>1100		-13.8	TD-41.25 27.50 - USE BAILER TO Remove SED.
7/2/18	0825	Pump	29.15		0.5	20.7	6.80	1019	0.48	869		-13.6	
7/2/18	0830	Pump	29.0		0.5	20.7	6.83	1085	0.27	>1100		-39.2	
7/2/18	0835	Pump	29.20		0.5	20.7	6.87	1243	0.22	802		-54.4	SURGED PUMP
7/2/18	0840	Pump	29.20		0.5	20.7	6.90	892	0.21	365		-53.8	
7/2/18	0845	Pump	28.70		0.5	20.6	6.90	1199	0.21	184		-56.9	SURGED PUMP
7/2/18	0850	Pump	29.10		0.5	20.6	6.93	1009	0.19	277		-55.9	
7/2/18	0855	Pump	29.0		0.5	20.7	6.91	1096	0.16	213		-59.8	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LH5MW46R
	Project Name: Longhorn Army Ammunition Plant	Project #: 60097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/2/18	0900	Pump	29.0		0.5	20.7	6.79	790	0.24	196		-46.8	
07/2/18	0905	Pump	29.1		0.5	20.6	6.86	844	0.17	105		-47.3	
07/2/18	0910	Pump	29.0		0.5	20.6	6.89	889	0.15	92.1		-49.0	
07/2/18	0915	Pump	29.05		0.5	20.7	6.90	961	0.13	74.2		-51.9	
07/2/18	0920	Pump	28.50		0.5	20.9	7.00	1360	0.16	123		-65.5	
07/2/18	0925	Pump	29.29		0.5	20.5	7.04	918	0.20	153		-68.0	
07/2/18	0930	Pump	29.12		0.5	20.7	6.95	907	0.15	72.6		-60.7	
07/2/18	0935	Pump	29.26		0.5	20.6	6.93	980	0.16	79.3		-58.4	
07/2/18	0940	Pump	29.25		0.5	20.6	6.95	1060	0.10	34.7		-60.0	
07/2/18	0945	Pump	29.25		0.5	20.6	6.93	1068	0.11	23.8		-59.0	
07/2/18	0950	Pump	29.30		0.5	20.6	6.93	1016	0.11	22.3		-58.2	
07/2/18	0955	Pump	29.29		0.5	20.6	6.93	971	0.11	140		-58.6	
07/2/18	1000	Pump	29.29		0.5	20.6	6.99	1200	0.09	42.7		-65.4	
07/2/18	1005	Pump	29.31		0.5	20.6	6.95	1095	0.10	35.8		-61.9	
07/2/18	1010	Pump	29.35		0.5	20.6	6.94	1100	0.08	18.8		-60.9	
07/2/18	1015	Pump	29.36		0.5	20.5	6.95	1092	0.08	10.1		-60.3	
07/2/18	1020	Pump	29.32		0.5	20.5	6.94	1095	0.08	7.57		-59.9	
07/2/18	1025	Pump	29.32		0.5	20.6	6.94	1098	0.08	4.91		-60.0	
07/2/18	1030	Pump			0.5	20.5	6.95	1096	0.08	2.41		-59.3	2 2/3 55 gallon drum 146 gallon

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

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LHS MW54

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW54	Date: 7/12/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: WTR Checked By: JM
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ YM407S	Water Level Indicator Type/ID #: GEOTECH #6162	
	Equipment Group:	Equipment Group:	
	Development Equipment: TORNADO PUMP	Equipment Decon.: ALCONOX & BUCKET	
WELL INFO	Casing I.D. (in) [a]: 4	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 19.50
	Total Well Depth (ft) [d]: 45.50 BTOC	Water Column Thickness (ft) [d-c]: 26.0'	Well Volume (gal) ([d-c] x b): 39.35
	Ground Condition of Well: Clear	Remarks: Has tubing	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( ) ORP	Remarks (odor, clarity, etc.)
7/12/18	1100	Pump	~~22.17~~	~~TNT~~		18.5	7.25	14143	0.20	317		—	Begin Sed Removal
	1105		22.70			18.7	6.55	1449	0.12	>1100		-22.2	
	1110		22.80		0.4	18.7	6.51	1452	0.28	>1100		-11.7	
	1115		22.90		0.4	18.6	6.49	1456	0.21	195		3.0	
	1120		23.10		0.4	18.5	6.45	1460	0.15	70.2		17.6	
	1125		23.20		0.4	18.6	6.43	1458	0.12	394		15.2	
	1130		23.20		0.4	18.7	6.43	1460	0.11	389		15.8	18 gallons
	1135		Begin	Surge		with		Bailer					
	1150		21.90		0.5	18.5	6.50	1440	0.22	239		49.6	
	1155		23.90		0.5	18.5	6.44	1449	0.16	153		50.1	
	1200		24.54		0.5	18.5	6.42	1459	0.12	105		48.0	Surge pump
	1205		24.70		0.5	18.5	6.40	1457	0.10	69.6		43.7	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

LHS, MW54

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHS MW54
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	Radiation ( ) ORP	Remarks (odor, clarity, etc.)
7/12/18	1210	Pump	25.20		0.5	18.6	6.40	1448	0.11	34.5		42.4	36 gallons
	1215		25.40		0.5	18.4	6.38	1457	0.07	29.1		39.2	
	1220		25.70		0.5	18.5	6.38	1456	0.07	29.1		38.8	
	1225		29.50		0.5	18.4	6.38	1467	0.07	18.4		39.4	55 gallons
	1230		Start Surge cycle										10 min 60 gallons
	1250		23.20		1.0	18.4	6.41	1488	0.22	171		60.9	
07/13/18	0930	Pump	19.50	5.0	1.0	18.4	7.02	1413	0.44	57.6		102.6	
	0935	Pump	22.70	5.0	1.0	18.4	6.84	1415	0.35	30.8		111.4	
	0940	Pump	23.35	5.0	1.0	18.5	6.74	1423	0.26	25.2		100.0	
	0945	Pump	23.50	5.0	1.0	18.5	6.64	1433	0.17	16.7		42.0	SURGE W/ PUMP
	0950	Pump	23.55	5.0	1.0	18.5	6.58	1460	0.06	33.0		12.7	
	0955	Pump	23.55	5.0	1.0	18.5	6.57	1443	0.07	33.1		26.0	
	1000	Pump	23.55	4.0	0.8	18.5	6.56	1441	0.07	24.7		25.7	
	1005	Pump	26.10	4.0	0.8	18.4	6.55	1420	0.07	14.2		33.3	
	1010	Pump	26.80	4.0	0.8	18.5	6.53	1425	0.05	8.99		29.4	STOP TO BAIL SED.
	1015	BAIL											
	1020	BAIL	20.90			18.7	6.86	1426	0.22	111		39.8	STOP BAIL, RESUME PUMPING
	1025	Pump	22.30			18.4	5.52	1423	0.12	73.5		43.0	
	1030	Pump	25.40			18.5	6.51	1427	0.10	52.2		40.0	
	1035	Pump	25.60			18.5	6.50	1436	0.06	20.2		34.6	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW54
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
7/13/18	1040	Pump	25.6	4.55	0.91	18.5	6.50	1434	0.06	17.0		34.9	
7/13/18	1045	Pump	25.6	4.55	0.91	18.5	6.50	1436	0.04	10.7		34.4	
07/13/18	1050	Pump	25.6	4.55	0.91	18.6	6.50	1431	0.04	9.61		36.1	
07/13/18	1055	Pump	25.8			18.6	6.49	1431	0.03	3.98		35.8	SURGE PUMP
07/13/18	1100	Pump	25.75			18.6	6.49	1407	0.03	45.0		35.4	
07/13/18	1105	Pump	25.78			18.6	6.49	1432	0.03	18.3		35.5	SURGE W/ PUMP
07/13/18	1110	Pump	25.60			18.6	6.49	1401	0.03	12.3		63.8	
07/13/18	1115	Pump	25.60			18.6	6.48	1415	0.03	10.3		38.3	
07/13/18	1120	Pump	25.60			18.6	6.48	1420	0.03	6.62		32.6	
07/13/18	1125	Pump	25.60			18.6	6.48	1421	0.03	4.19		38.2	
07/13/18	1130	Pump	25.60			18.6	6.48	1424	0.03	3.56		35.0	3 DRUMS, 165 GAL.

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW55R	Date: 07/03/18
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: YSI/GEOTECH TURB. METER		Water Level Indicator Type/ID #: GEOTECH #6162
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP		Equipment Decon.: ALCONOX/BUCKET
WELL INFO	Casing I.D. (in) [a]: 4 in.	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 24.55
	Total Well Depth (ft) [d]: 42.2	Water Column Thickness (ft) [d-c]: 13.65	Well Volume (gal) ([d-c] x b):
	Ground Condition of Well:		Remarks: 20.32 = 1 WELL VOLUME

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
~~NEW~~ 07/03/18	1150		24.55										INT
07/03/18	1155		27.65		2.0	19.7	6.36	2658	2.21	>1100		119.5	
07/03/18	1200		27.83		2.0	18.3	6.55	3537	0.93	>1100		120.4	
07/03/18	1205	SURGE BLOCK	27.64										SURGE BLOCK
07/03/18	1210	SURGE BLOCK											SURGE BLOCK
07/03/18	1215	SURGE BLOCK	24.37		2.0	18.5	6.64	3565	0.37	>1100		114.7	SURGE BLOCK
07/03/18	1220	PUMP	27.10		2.0	18.4	6.63	3911	0.54	>1100		117.4	
07/03/18	1225	PUMP	27.69		2.0	18.3	6.63	4357	0.28	536		118.7	
07/03/18	1230	PUMP	27.78		2.0	18.3	6.63	4562	0.14	196		119.8	
07/03/18	1235	SURGE BLOCK	27.78										SURGE BLOCK
07/03/18	1240	SURGE BLOCK											SURGE BLOCK
07/03/18	1245	SURGE BLOCK	24.40		2.0	18.8	6.76	3840	0.34	>1100		113.3	SURGE BLOCK

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND
4) remove water added during drilling and construction

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW55R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP	Remarks (odor, clarity, etc.)
07/03/18	1250	Pump	27.68		2.0	18.4	6.65	4433	0.40	519		117.6	
07/03/18	1255	Pump	27.80		2.0	18.3	6.64	4622	0.17	101		118.5	
07/03/18	1300	SURGE BLOCK	27.80										
07/03/18	1305	SURGE BLOCK											
07/03/18	1310	SURGE BLOCK	24.25		2.0	18.4	6.62	4582	0.43	514		117.5	
07/03/18	1315	Pump	27.80		2.0	18.3	6.63	4720	0.18	98.8		118.5	
07/03/18	1320	Pump	27.80		2.0	18.3	6.64	4600	0.10	32.4		117.5	
07/03/18	1325	Pump	27.80		2.0	18.3	6.64	4608	0.08	20.7		116.0	
07/03/18	1330	Pump	27.85		2.0	18.3	6.64	4719	0.06	24.9		114.8	
07/03/18	1335	Pump	27.90		2.0	18.3	6.65	4885	0.05	14.0		113.7	
07/03/18	1340	Pump	27.90		2.0	18.3	6.61	4829	0.05	9.13		114.7	
07/08/18	1345	Pump	27.90		2.0	18.3	6.65	4805	0.05	3.66		112.2	
07/08/18	1350	Pump	27.90		2.0	18.3	6.65	4795	0.05	0.87		112.5	3 DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW56R	Date: 07/02/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 100797916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: YSI/GEOTECH TURB. METER		Water Level Indicator Type/ID #: GEOTECH #6162
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP		Equipment Decon.: ALCONOX
WELL INFO	Casing I.D. (in) [a]: 4 IN.	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 20.40
	Total Well Depth (ft) [d]: 37.65 FT	Water Column Thickness (ft) [d-c]: 13.25	Well Volume (gal) ([d-c] x b):
	Ground Condition of Well:		Remarks: SOP CALC. = 20 GAL/1 WELL VOLUME

CASING INFO											
	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	Radiation ( ) ORA	Remarks (odor, clarity, etc.)
~~07/02/18~~	~~1520~~		~~24.40~~										~~INT.~~
07/02/18	1530	Pump	25.92	3	0.6	20.1	6.16	1598	15.2	270		76.2	INT.
07/2/18	1535	Pump	28.35		0.6	19.5	6.22	1582	0.37	>1100		61.1	SURGING
07/02/18	1540	Pump	27.50		0.6	20.4	6.21	1601	0.27	>1100		54.2	
07/02/18	1545	Pump	27.00		0.6	20.2	6.21	1581	0.25	>1100		47.5	
07/02/18	1550	Pump	27.40		0.6	19.8	6.22	1660	0.45	926		45.3	
07/02/18	1555	~~Bail~~ Pump	27.60		0.6								SURGING W/ BAILER
07/02/18	1605	~~Pump~~ Bail	25.80		0.6	20.1	6.52	1626	0.73	>1100		44.0	STOP SURGING
07/02/18	1610	Pump	28.00		0.6	19.5	6.27	1624	0.62	>1100		49.9	
07/02/18	1615	Pump	27.64		0.6	19.8	6.23	1619	0.65	>1100		45.0	
07/02/18	1620	Pump	27.44		0.6	19.8	6.23	1620	0.62	>1100		43.2	
07/02/18	1625	Pump	27.39	↓	0.6	19.8	6.24	1615	0.64	>1100		41.5	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW56R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/02/18	1630	Pump	27.4	3	0.3	19.7	6.23	1621	0.61	>1100		41.1	
07/02/18	1635	Pump	27.34	↓	0.3	19.8	6.24	1633	0.50	696		41.4	
07/02/18	1640	Pump	27.34	↓	0.3	19.6	6.26	1623	0.50	534		40.6	STOP SURGING FOR DAY
07/03/18	0736		24.32	↓									INT. WATER LEVEL
07/03/18	0745	Pump	27.60	1.5	0.3	19.0	6.18	1659	0.35	—		—	CUT OFF PUMP, LOW WATER
07/03/18	0750	Pump	27.10	↓	↓	19.0	6.19	1648	0.60	>1100		197.0	
07/03/18	0755	Pump	26.50	↓	↓	19.2	6.25	1654	0.54	117		181.7	
07/03/18	0800	Pump	27.25	↓	↓	19.3	6.21	1652	0.43	204		159.9	
07/03/18	0805	Pump	27.28	↓	↓	19.1	6.23	1649	0.39	126		144.0	
07/03/18	0810	Pump	27.15	↓	↓	19.3	6.25	1658	0.37	104		131.7	
07/03/18	0815	Pump	27.10	↓	↓	19.3	6.26	1657	0.34	108		124.7	START SURGE & BAIL
07/03/18	0820	BAIL		↓	↓								BAIL SEDIMENT OFF BOTTOM
07/03/18	0825	BAIL		↓	↓								BAIL SED. OFF BOTTOM
07/03/18	0830	Pump	25.95	↓	↓	19.4	6.42	1653	0.75	>1100		114.3	
07/03/18	0835	Pump	27.17	↓	↓	19.3	6.25	1649	0.59	>1100		110.1	
07/03/18	0840	Pump	27.30	↓	↓	19.4	6.26	1651	0.52	990		103.4	
07/03/18	0845	Pump	23.8	↓	↓	19.4	6.27	1644	0.73	595		97.1	
07/03/18	0850	Pump	27.70	↓	↓	19.4							STOP PUMP TO RECHARGE WELL
07/03/18	0855	Pump	26.00	↓	↓	19.5	6.36	1649	0.52	215		93.1	
07/03/18	0900	Pump	27.85	↓	↓	19.1	6.29	1668	0.35	129		94.4	WELL RECHARGE SLOW

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW56R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/03/18	0905	~~BAIL~~ PUMP											
07/03/18	0910	BAIL											BAIL SED. OFF BOTTOM
07/03/18	0915	Pump	24.99	1.8	0.36	20.7	6.52	1642	0.62	>1100		85.7	" "
07/03/18	0920	Pump	26.67			19.7	6.30	1637	0.48	>1100		88.7	
07/03/18	0925	Pump	26.35			19.9	6.22	1637	0.45	>1100		85.4	
07/03/18	0930	Pump	26.32			19.7	6.22	1634	0.47	>1100		78.9	
07/03/18	0935	Pump	27.12			19.4	6.23	1636	0.55	850		77.6	
07/03/18	0940	Pump	26.99			19.8	6.25	1637	0.48	656		74.7	
07/03/18	0945	Pump	27.00			19.6	6.27	1636	0.46	419		72.7	
07/03/18	0950	Pump	27.32			19.4	6.27	1649	0.34	206		72.4	
07/03/18	0955	Pump	28.05			19.4	6.25	1629	0.40	432		69.9	
07/03/18	1000	Pump	27.8			19.4	6.29	1651	0.26	461		67.8	
07/03/18	1005	Pump	27.9			19.5	6.30	1651	0.32	947		67.1	
07/03/18	1010	Pump	27.81			19.5	6.29	1650	0.37	785		66.7	
07/03/18	1015	Pump	27.81			19.4	6.30	1649	0.44	413		66.1	
07/03/18	1020	Pump	27.90			19.5	6.29	1646	0.44	212		65.6	
07/03/18	1025	Pump	27.90			19.3	6.30	1646	0.35	61.0		64.7	
07/03/18	1030	Pump	27.90			19.4	6.30	1646	0.33	36.0		63.6	
07/03/18	1035	Pump	27.90			19.4	6.29	1643	0.33	19.5		63.2	
07/03/18	1040	Pump	27.90			19.4	6.29	1639	0.30	13.2		62.4	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW56R
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ( ) ORP	Remarks (odor, clarity, etc.)
07/03/18	1045	Pump	27.84	1.8	0.36	19.4	6.29	1639	0.29	4.45		61.5	
07/03/18	1050	Pump	27.80	↓	↓	19.4	6.29	1639	0.31	3.00		61.2	
07/03/18	1055	Pump	27.90	↓	↓	19.4	6.29	1637	0.28	0.60		60.3	2 3/4 DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

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MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW57	Date: 07/11/2018
	Project Name: Longhorn Army Ammunition Plant	Project #: 10097916	Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: PRO+ 4M4075		Water Level Indicator Type/ID #: GEOTECH # 5886
	Equipment Group:		Equipment Group:
	Development Equipment: TORNADO PUMP		Equipment Decon.: ALCONOX / BUCKET
WELL INFO	Casing I.D. (in) [a]: 4"	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]: 7.75
	Total Well Depth (ft) [d]: 17.45	Water Column Thickness (ft) [d-c]: 9.7	Well Volume (gal) {[d-c] x b}: 11.12
	Ground Condition of Well:		Remarks:

CASING INFO										
Casing I.D. (in) [a]: 4"	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/11/18	1350	Pump	12.50			19.3	7.85	145.3	0.36	431		172.3	INT.
07/11/18	1355	Pump	13.70			18.9	6.00	224.6	0.17	>1100		177.5	LOWER PUMP TO BOTTOM BOTTOM SEDIMENT
~~07/11/18~~	~~1400~~	~~Pump~~	~~15.75~~										JM
07/11/18	1400	Pump	17.0			19.2	5.76	115.4	0.86	>100		160.2	STOP PUMP TO ALLOW RECHARGE
07/11/18	1405		17.0										DOES NOT RECHARGE, WILL CHECK TOMORROW
07/12/18	1015		16.8										DRY, NO RECHARGE

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47		LocID: LHSMW60		Date: 07/14/18
	Project Name: Longhorn Army Ammunition Plant		Project #: 10097916		Recorded By: JM Checked By: WTR
EQUIPMENT	Water Quality Meter Type/ID #: GEOTECH TURB #6382, YSI # PRO+4M4075			Water Level Indicator Type/ID #: GEOTECH #5886	
	Equipment Group:			Equipment Group:	
	Development Equipment: TORNADO PUMP & BAILER			Equipment Decon.: ALCONOX & BUCKET	
WELL INFO	Casing I.D. (in) [a]: 4"		Unit Casing Volume (gal/lin ft) [b]:		Initial Depth to Water (ft) [c]: 22.3
	Total Well Depth (ft) [d]: 29.50		Water Column Thickness (ft) [d-c]: 7.2		Well Volume (gal) ([d-c] x b): 8.25 GAL
	Ground Condition of Well:			Remarks:	

CASING INFO											
Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conductivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mL/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/14/18	1015	Pump	22.30	0.90	0.18	18.8	6.90	1558	1.19	103		88.5	INT., SURGE W/ PUMP
07/14/18	1020	Pump	25.20	↓	↓	18.5	6.00	1534	1.06	>1100		43.6	STOP PUMP FOR RECHARGE
07/14/18	1025	—	23.70										STILL RECHARGING
07/14/18	1030	Pump	22.80			19.4	6.16	1547	1.23	466		57.7	RESUME PUMPING
07/14/18	1035	Pump	23.80			19.1	6.10	1563	1.68	429		57.5	
07/14/18	1040	Pump	23.80			19.2	6.10	1562	1.68	450		63.7	
07/14/18	1045	Pump	23.75			19.3	6.11	1561	1.54	312		69.9	
07/14/18	1050	Pump	23.96			19.5	6.11	1564	1.34	463		73.0	SURGE W/ PUMP
07/14/18	1055	Pump	23.98	↓	↓	19.1	6.12	1561	1.21	213		77.8	STOP PUMP TO BAIL SED.
07/14/18	1100	BAIL											
07/14/18	1110	BAIL											STOP PUMP FOR RECHARGE
07/14/18	1240	Pump	22.02	0.9	0.18	21.0	6.31	1575	1.71	>1100		111	

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW160
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP ~~Radiation~~ ( )	Remarks (odor, clarity, etc.)
07/14/18	1420	~~BAIL~~	23.50			18.4	6.29	1577	1.82			115.9	~~BAIL SED.~~ RESUME PUMPING
07/14/18	1425	—											ALLOW RECHARGE
07/14/18	1430	PUMP	24.20			19.1	6.24	1601	1.83	>1100		112.9	
07/14/18	1435	PUMP	24.85			18.9	6.24	1637	1.56	225		117.1	
07/14/18	1440	PUMP	24.20			19.6	6.22	1628	1.26	111		117.6	STOP PUMP TO BAIL
07/14/18	1445	BAIL											
07/14/18	1450	BAIL											
07/14/18	1455	BAIL											
07/14/18	1500	BAIL											
07/14/18	1505	BAIL											
07/14/18	1510	BAIL											STOP BAIL TO RECHARGE
07/14/18	1515	—											
07/14/18	1520	—											
07/14/18	1525	—											
07/14/18	1530		20.20			19.5	6.52	1603	2.80	>1100		134.9	RESUME PUMPING
07/14/18	1535												STOP PUMPING FOR DAY, WILL RESUP A
07/15/18	1105	PUMP	22.50			18.4	6.41	1637	3.49	>1100		88.4	
07/15/18	1110	—	29.00										STOP PUMP TO ALLOW RECHARGE
07/15/18	1120	PUMP	23.20			19.9	6.51	1688	4.05	164		93.7	
07/15/18	1125	—											STOP PUMP TO ALLOW RECHARGE

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW60
	Project Name: Longhorn Army Ammunition Plant	Project #: 100979116

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	ORP Radiation ( )	Remarks (odor, clarity, etc.)
07/14/18	1245	Pump	23.16			20.0	6.00	1570	1.68	553		125.0	
07/14/18	1250	Pump	23.29			20.2	6.02	1579	1.59	461		123.6	
07/14/18	1255	Pump	23.29	↓	↓	19.7	6.05	1589	1.47	297		121.7	
07/14/18	1300	Pump	23.31	0.90	0.18	20.2	6.08	1600	1.12	156		120.2	
07/14/18	1305	Pump	23.41			19.8	6.08	1591	0.99	147		118.2	
07/14/18	1310	Pump	23.30			20.0	6.07	1559	0.87	168		118.6	
07/14/18	1315	Pump	23.25			21.1	6.08	1558	0.86	83.4		118.1	
07/14/18	1320	Pump	23.30			19.7	6.09	1561	0.82	71.7		118.0	
07/14/18	1325	Pump	23.30	↓	↓	20.5	6.10	1574	0.74	60.4		118.0	STOP PUMP TO BAIL SED.
07/14/18	1330	BAIL											
07/14/18	1335	BAIL											STOP BAIL, RESUME PUMPING, ALLOW RECHARGE
~~07/14/18~~	~~1340~~												RECHARGE
07/14/18	1340	Pump	22.90			18.6	6.30	1453	1.90	1100		119.8	RESUME PUMPING
07/14/18	1345	Pump	25.66			19.4	6.16	1571	1.84	948		120.8	
07/14/18	1350	Pump	25.09			19.6	6.20	1611	2.42	358		120.6	
07/14/18	1355	Pump	24.20			20.5	6.22	1620	2.48	252		119.0	
07/14/18	1400	Pump	23.85			19.8	6.25	1645	2.66	62.3		117.7	
07/14/18	1405	Pump	23.67			19.7	6.24	1656	2.17	36.0		117.2	
07/14/18	1410	Pump	23.65			19.6	6.23	1655	1.90	21.4		116.7	
07/14/18	1415	BAIL											BAIL SED. STOP PUMP

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, **AND**

4) remove water added during drilling and construction

MONITORING WELL DEVELOPMENT FORM

LOCATION	Site: LHAAP-47	LocID: LHSMW60
	Project Name: Longhorn Army Ammunition Plant	Project #: 100977916

Date	Time (24 hr)	Method (pump, surge, bail)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (gpm)	Temp. (C)	pH	Conduc-tivity (mS/cm)	DO (mg/L)	Turb. (NTU)	Sed. (mg/L)	~~Radiation~~ ORP ( )	Remarks (odor, clarity, etc.)
07/15/18	1135	Pump		0.9	0.18	19.7	6.45	1716	3.24			97.9	RESUME PUMPING
07/15/18	1140	Pump	23.80	0.9	0.18	19.2	6.25	1720	2.40	30.6		100.4	
07/15/18	1145	Pump	24.00	0.9	0.18	18.9	6.19	1681	1.53	10.9		103.5	
07/15/18	1150	Pump	24.15	0.9	0.18	19.0	6.17	1659	1.27	0.42		105.2	
07/15/18	1155	Pump	23.30	0.9	0.18	21.5	6.17	1670	1.25	4.18		105.9	
07/15/18	1200	Pump	23.50	0.9	0.18	19.4	6.20	1681	1.08	0.02		106.5	
07/15/18	1205	Pump	23.50	0.9	0.18	19.6	6.18	1665	0.98	0.02		107.6	
07/15/18	1210	Pump	23.50	0.9	0.18	19.7	6.18	1660	0.83	0.02		107.8	
07/15/18	1215	Pump	23.50	0.9	0.18	19.5	6.17	1654	0.73	0.02		108.4	
07/15/18	1220	Pump	23.50	0.9	0.18	19.3	6.17	1647	0.63	0.02		109.7	
07/15/18	1225	Pump	23.60	0.9	0.18	19.5	6.17	1640	0.58	0.02		110.3	
07/15/18	1230	Pump	23.80	0.9	0.18	19.3	6.18	1642	0.60	0.02		110.8	
07/15/18	1235	Pump	23.80	0.9	0.18	19.7	6.18	1645	0.64	0.02		111.1	1.5 DRUMS

Development Criteria: 1) sediment <0.75 mL/L, 2) turbidity within 10 NTU range for 30 minutes, 3) +/- 0.5 C, +/- 0.1 pH, +/- 3 % conductivity, +/- 10% DO for 3 consecutive readings, AND 4) remove water added during drilling and construction

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Well Sample Forms

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW46R	Samplers : END, PW, JM
Date : 07/19/2018	Project : LHAAP-47

Equipment

Pump : Geo control PRO
Water Level Meter : Geotech
Parameter Meter : YSI 556 / Geotech turbidity
Turbidity Meter: "

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4" ID	27.60' btoc	27.67' btoc	39'	6.5 L

Sample ID : 1907LHSMW46R	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: Perchlorate, VOCs, Metals, SVOCs	7
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y (N)

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0840	27.56	150/min	0.150	22.3	963	7.73	1.90	-43.8	18.3
0850	27.69	150	1.5	21.9	975	7.73	1.62	-59.2	6.85
0853	27.66	150	2.0	21.8	975	7.72	1.39	-63.8	5.34
0857	27.66	150	2.5	21.8	974	7.72	1.41	-65.8	4.51
0901	27.69	150	3.0	21.7	971	7.71	1.36	-65.3	3.68
0904	27.68	150	3.5	21.8	961	7.70	1.44	-65.7	2.47
0909	27.68	150	4.2	21.9	962	7.63	1.40	-66.1	2.43
0912	27.67	150	4.7	22.0	964	7.66	1.36	-70.2	2.22
0916	27.68	150	5.1	22.1	970	7.40	1.20	-73.5	0.82
0920	27.68	150	5.5	22.0	979	7.42	1.12	-77.7	0.89
0926	27.67	150	6.5	21.9	981	7.49	1.05	-78.2	0.52
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 0940	Sampler's Signature:	Checked by : JM

00916277

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW08R	Samplers : FN
Date : 07/19/2018	Project : LHAAP-47

Equipment

Pump : Geotech PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI 556	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4" ID	27.95' btoc	28.10' btoc	38'	4.0 L

Sample ID : 190747WW08R	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, metals	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / (N)

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1238	28.05	180	0.5	26.1	4252	7.54	0.79	46.6	6.79
1242	28.10	180	1.2	26.2	4240	7.56	0.54	61.0	4.78
1245	28.10	180	1.9	26.2	4254	7.58	0.52	54.4	5.03
1248	28.10	180	2.5	26.3	4242	7.59	0.46	56.3	4.91
1251	28.10	180	3.1	26.2	4248	7.55	0.39	54.5	4.47
1255	28.10	180	3.9	26.2	4240	7.49	0.38	52.7	3.94
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1300	Sampler's Signature:	Checked by : PW

00916278

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW43R	Samplers : EN
Date : 07/19/2018	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO
Water Level Meter : Geotech
Parameter Meter : YSI 556
Turbidity Meter: Geotech

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4" ID	26.32' btoc	26.43' btoc	34'	2.1 L

Sample ID : 1907LHSMW43R	**Analyses :** VOCs, perchlorate	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses:	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SAA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1407	26.42	120	0.5	22.9	2840	7.77	2.10	101.9	2.29
1410	26.42	120	0.9	22.3	2827	7.79	1.82	68.6	2.10
1413	26.42	120	1.3	22.2	2828	7.78	1.62	63.7	2.03
1416	26.43	120	1.7	22.4	2828	7.70	1.76	73.1	1.67
1419	26.43	120	2.1	22.2	2829	7.69	1.69	68.3	2.89
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1425	Sampler's Signature:	Checked by : PW

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW11R		Samplers : EN		
Date : 07/19/18		Project : LHAAP-47 PSI		
Equipment				
Pump : Geocontrol PP20				
Water Level Meter : Geotech				
Parameter Meter : YSI 556				
Turbidity Meter: Geotech				
Casing Diameter : 4" ID	Initial Water Level : 24.20' btoc	Final Water Level : 26.30' btoc	Total Well Depth : 35'	Purge Volume (Total): 2.5L

Sample ID : 1907 47WW11R	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: Explosives, perchlorate	3
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SAA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1512	26.30	130	0.5	24.7	5430	7.91	0.46	-30.0	5.70
1515	26.30	130	0.9	23.9	5448	8.13	0.39	-42.7	1.36
1518	26.30	130	1.3	23.6	5463	8.14	0.36	-44.0	2.41
1521	26.30	130	1.7	23.7	5422	8.20	0.28	-49.3	0.67
1524	26.30	130	2.1	23.7	5435	8.24	0.26	-46.0	0.77
1527	26.30	130	2.5	23.6	5424	8.30	0.27	-46.6	0.80
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1545	Sampler's Signature:	Checked by : PW

00916280

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW32	Samplers : EN
Date : 07/19/2018	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI 556	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
2"	24.14' btoc	24.55' btoc	29'	2.7 L

Sample ID : 190747WW32	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs	3
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SAA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTUs)
1700	24.50	100	0.3	22.8	8555	7.44	1.78	92.1	7.64
1703	24.48	100	0.6	22.6	8495	7.45	1.61	91.7	8.84
1706	24.44	100	0.9	22.2	8357	7.67	1.44	93.2	5.45
1709	24.45	100	1.2	22.0	8315	7.73	1.37	97.5	3.91
1712	24.45	100	1.5	22.1	8339	7.76	1.26	100.1	4.41
1715	24.58	100	1.8	21.9	8345	7.77	1.38	103.8	3.69
1718	24.48	100	2.1	21.9	8327	7.79	1.34	106.3	1.66
1721	24.50	100	2.4	21.8	8329	7.80	1.32	109.6	1.39
1724	24.55	100	2.7	22.0	8313	7.82	1.24	110.0	1.15
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1730	Sampler's Signature:	Checked by : PW

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW39	Samplers : JM
Date : 07/19/2018	Project : LHAAP-47PSI

Equipment

Pump : GEOTECH BLADDER PUMP
Water Level Meter : GEOTECH #5886
Parameter Meter : GEOTECH PRO+4M3897
Turbidity Meter: GEOTECH #6120

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	23.83' BTOC	24.81' BTOC	39.00	2.70L

Sample ID : 190747WW39	**Analyses :** PERCHLORATE, VOCs	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses:	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1140	23.83	150 mL	0.00	23.4	1074	6.62	6.99	135.0	0.02
1143	24.10	150mL	0.45	23.9	1068	6.59	6.38	125.2	0.02
1146	24.31	150mL	0.90	23.5	1075	6.66	6.64	124.0	0.02
1149	24.34	150mL	1.35	23.2	1071	6.67	6.56	123.4	0.02
1152	24.40	150mL	1.80	23.4	1069	6.70	6.17	123.2	0.02
1155	24.52	150mL	2.25	23.3	1070	6.70	6.14	122.8	0.02
1158	24.60	150mL	2.70	23.6	1068	6.71	6.10	116.8	0.02
		~~150mL~~							
		~~150mL~~							
		~~150mL~~							
		~~150mL~~							

Stabilization Criteria :		± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs
Sample Time : 1200	Sampler's Signature:			Checked by : PW/EN			

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW29	Samplers : JM
Date : 07/19/2018	Project : LHAAP-47PSI

Equipment

Pump : GEOTECH BLADDER PUMP	
Water Level Meter : GEOTECH #5886	
Parameter Meter : GEOTECH PRO+4M3897	
Turbidity Meter: GEOTECH #6120	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	21.76' BTOC	21.96' BTOC	62.50'	6.30L

Sample ID : 190747WW29	**Analyses :** PERCHLORATE, VOC's	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses:	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1430	21.76	150mL	0.00	29.9	1434	6.61	5.49	76.1	3.63
1433	21.91	150mL	0.45	24.9	1420	6.62	5.94	77.5	2.73
1436	21.93	150mL	0.90	24.5	1415	6.63	5.24	79.4	1.47
1439	21.92	150mL	1.35	25.0	1404	6.62	4.76	80.9	1.56
1442	21.94	150mL	1.80	24.3	1410	6.62	4.80	82.7	0.82
1445	21.97	150mL	2.25	24.4	1410	6.61	5.22	78.6	1.28
1448	21.95	150mL	2.70	24.4	1406	6.60	5.10	75.2	1.11
1451	21.96	150mL	3.15	24.5	1408	6.61	4.94	69.5	0.31
1454	21.95	150mL	3.60	24.4	1405	6.61	5.04	67.9	0.51
1457	21.95	150mL	4.05	24.4	1400	6.60	4.96	67.3	0.54
1500	21.94	150mL	4.50	24.3	1398	6.60	4.86	63.2	0.56
1503	21.94	150mL	4.95	24.4	1399	6.60	4.85	60.0	0.56
1506	21.96	150mL	5.40	24.4	1389	6.60	4.80	59.1	0.33
1509	21.95	150mL	5.85	24.5	1390	6.60	4.79	56.9	0.30
1512	21.96	150mL	6.30	24.5	1387	6.60	4.78	55.4	0.27
Stabilization Criteria :				±1°	±10%	±0.1	±10%	±10	±10% and under 50 NTUs

Sample Time : 1520	Sampler's Signature:	Checked by : PW/EN

00916283

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW31	Samplers : JM
Date : 07/19/2018	Project : LHAAP-47PSF

Equipment

Pump : GEOTECH BLADDER PUMP	
Water Level Meter : GEOTECH #5886	
Parameter Meter : GEOTECH PRO-4M3897	
Turbidity Meter: GEOTECH #6120	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	26.80' BTOC	26.98' BTOC	52.5'	5.40L

Sample ID : 190747WW31	**Analyses :** VOCs	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses:	3
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1640	26.80	150mL	0.00	31.7	7027	6.92	3.80	133.9	40.0
1643	26.94	150mL	0.45	22.5	7503	6.92	2.96	120.9	8.62
1646	26.91	150mL	0.90	22.7	7340	6.94	2.33	116.8	4.02
1649	26.96	150mL	1.35	22.4	7404	6.94	2.20	114.4	1.52
1652	26.99	150mL	1.80	22.1	7431	6.94	1.92	111.8	1.62
1655	27.01	150mL	2.25	22.4	7420	6.94	1.86	110.0	0.02
1658	26.94	150mL	2.70	21.7	7450	6.94	1.86	108.1	0.24
1701	27.00	150mL	3.15	21.9	7463	6.94	1.90	120.4	0.02
1704	26.99	150mL	3.60	22.0	7514	6.94	1.66	123.8	0.02
1707	26.98	150mL	4.05	22.4	7508	6.94	1.82	124.0	0.02
1710	27.03	150mL	4.50	21.8	7464	6.94	1.78	130.2	0.02
1713	27.05	150mL	4.95	22.4	7473	6.94	1.70	130.4	0.02
1716	26.98	150mL	5.40	22.3	7433	6.94	1.71	131.7	0.02
Stabilization Criteria :				±1°	±10%	±0.1	±10%	±10	±10% and under 50 NTUs

Sample Time : 1725 | Sampler's Signature: | Checked by : PW / EN

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW60	Samplers : END
Date : 07/20/2018	Project : LHAAP-47

Equipment

Pump : GeoControl PRO				
Water Level Meter : Geotech				
Parameter Meter : YSI 556				
Turbidity Meter: Geotech				
Casing Diameter : 4" ID	Initial Water Level : 22.45' btoc	Final Water Level : 22.62' btoc	Total Well Depth : 26'	Purge Volume (Total): 3.0 L

Sample ID : 2007LHSMW60	**Analyses :**	**# of Bottles**
QC Samples: (FD) FS RB (MS/MSD)	Analyses: VOCs, SVOCs, perchlorate, explosives, metals	36
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y (N)

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0949	22.58	130	0.5	21.8	1613	7.31	0.98	101.1	6.37
0953	22.61	130	1.0	21.6	1604	7.05	0.80	105.3	3.95
0956	22.61	130	1.4	21.7	1603	6.92	0.78	107.4	3.77
0959	22.61	130	1.8	21.7	1603	6.85	0.79	109.9	3.08
1002	22.61	130	2.2	21.8	1601	6.81	0.76	111.6	3.05
1005	22.62	130	2.6	21.9	1601	6.79	0.74	111.9	2.12
1008	22.62	130	3.0	21.8	1600	6.76	0.76	112.5	2.08
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1015 | Sampler's Signature: | Checked by : PW

DUP-01 1200

00916285

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW55R	Samplers : EN
Date : 07/20/2018	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI 556	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4" ID	24.70' btoc	24.80' btoc	35'	2.3 L

Sample ID : 2007LHSMW55R	**Analyses :**	**# of Bottles**
QC Samples: (FD) FS RB MS/MSD	Analyses: VOCs, perchlorate	8
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1345	24.79	100	0.5	24.4	2164	7.25	1.22	82.8	1.87
1348	24.79	100	0.8	24.0	2160	7.25	0.97	69.6	0.43
1351	24.79	100	1.1	23.4	2156	7.27	0.80	60.8	1.02
1354	24.79	100	1.4	23.4	2156	7.26	0.71	54.0	1.62
1357	24.80	100	1.7	23.1	2156	7.26	0.67	52.5	0.72
1400	24.80	100	2.0	23.1	2153	7.25	0.65	50.1	0.89
1403	24.80	100	2.3	23.0	2156	7.24	0.64	49.0	1.05
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1410	Sampler's Signature:	Checked by : PW

DUP-02 1500

00916286

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW23	Samplers : RW
Date : 7/20/18	Project : LHAAP-47 PSI

Equipment

Pump : GeoTech Bladder	
Water Level Meter : GeoTech	
Parameter Meter : YSI 556	
Turbidity Meter: GeoTech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	BTOC 25.1	BTOC 25.1	32	2,860 mL

Sample ID : 20074WW23	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, Perchlorates	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: VOCs, Perchlorate	

Well Conditions, Remarks

Pump Depth - 28 BTOC

Metals Filtered : Y / N

Time	Depth to Water (ft) ~~BTOC~~	Pumping Rate (mL/min)	Purge Volume (mL)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0925	25.1	130	130	23	754.4	6.8	4.24	69.2	2.7
0928	25.1	—	520	23.8	754.3	6.7	3.79	69.3	1.4
0931	25.1	—	910	22.6	775	6.7	3.72	69.9	2.15
0934	25.1	—	1,300	23.1	774	6.7	3.76	70.4	2.02
0937	25.1	—	1,690	23.8	776	6.7	3.57	72.8	2.02
0940	25.1	—	2,080	23.7	773	6.7	3.28	72.9	2.02
0943	25.1	—	2,470	23.7	773	6.7	3.3	73.7	2.02
0946	25.1	—	2,860	23.4	776	6.7	3.24	74.7	2.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1010	Sampler's Signature:	Checked by :	EN

00916287

HDR

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW25R	Samplers : RJW
Date : 7/20/18	Project : CHAAP-47 PSI

Equipment

Pump : GeoTech Bladder

Water Level Meter : GeoTech

Parameter Meter : YSI 556

Turbidity Meter: GeoTech

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	BTOC 30'	BTOC 30.1'	39.5	4.65L

Sample ID :	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs	3
Full Sample: (Y) N		
Partial Sample: Y N	Analyses Collected: SAA	

Well Conditions, Remarks

Pump Depth - 35' BTOC

Metals Filtered : Y / N

Time	Depth to Water BTOC (ft)	Pumping Rate mL/min	Purge Volume mL	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1130	30'	150	150	23.8	1443	7.15	1.95	96.8	2.49
1133	30.1	~	600	24.4	1427	7.0	1.46	95.6	4.82
1136	30.1	~	1050	22.9	1431	7.0	1.43	96.0	2.84
1139	30.1	~	1500	21.7	1425	7.0	1.14	95.6	<2.02
1142	30.2	~	1950	22.8	1419	7.0	1.04	94.9	<2.02
1145	30.2	~	2400	22.2	1423	7.0	1.01	95.3	<2.02
1148	30.2	~	2850	23.0	1426	7.0	1.06	95.5	<2.02
1151	30.1	~	3300	22.1	1420	7.0	1.06	95.3	<2.02
1154	30.1	~	3750	22.1	1417	7.0	1.0	94.4	<2.02
1157	30.1	~	4200	22.2	1416	7.0	1.03	93.8	<2.02
1200	30.1	~	4650	22.1	1416	7.0	1.0	93.6	<2.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1215 | Sampler's Signature: [signature] | Checked by : EO

00916288

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Low - Flow Groundwater Sampling Data Sheet

Well ID : ~~47WW09~~ JM 47WW06	Samplers : JM
Date : 07/20/2018	Project : LHAAP-47PSI

Equipment

Pump : GEOTECH BLADDER PUMP
Water Level Meter : GEOTECH #5886
Parameter Meter : GEOTECH PRO+4M4076
Turbidity Meter: GEOTECH #6120

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	27.71' BTOC	28.64' BTOC	47.90'	5.85L

Sample ID : 20074 7WW06	**Analyses :** METALS	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses:	1
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y (N)

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1055	27.71	150 mL	0.00	23.5	1634	6.69	5.16	104.2	22.4
1058	27.91	150 mL	0.45	21.2	1633	6.47	1.06	102.8	16.8
1101	27.98	150 mL	0.90	21.4	1630	6.46	0.72	99.1	15.3
1104	28.09	150 mL	1.35	21.4	1631	6.46	0.80	97.7	13.1
1107	28.21	150 mL	1.80	21.6	1626	6.47	0.67	95.4	12.9
1110	28.28	150 mL	2.25	21.2	1630	6.47	0.79	92.9	13.3
1113	28.29	150 mL	2.70	21.1	1628	6.48	0.58	90.8	11.4
1116	28.32	150 mL	3.15	21.3	1631	6.48	0.53	88.0	14.5
1119	28.41	150 mL	3.60	21.2	1627	6.48	0.49	85.3	11.1
1122	28.45	150 mL	4.05	21.4	1624	6.49	0.48	81.8	09.79
1125	28.82	150 mL	4.50	21.2	1630	6.48	0.59	78.9	09.82
1128	28.62	150 mL	4.95	21.2	1626	6.49	0.48	76.7	08.37
1131	28.60	150 mL	5.40	21.3	1624	6.48	0.46	74.3	08.43
1134	28.64	150 mL	5.85	21.1	1622	6.49	0.45	70.4	08.10
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1140 | Sampler's Signature: | Checked by : PW/EN

00916289

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW14	Samplers : JM
Date : 07/20/2018	Project : LHAAP-47PSI

Equipment

Pump : GEOTECH BLADDER PUMP	
Water Level Meter : GEOTECH #5886	
Parameter Meter : GEOTECH PRO+4M4076	
Turbidity Meter: GEOTECH #6120	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	29.53' BTOC	29.76' BTOC	49.0' ~~BTOC~~ JM	3.60L

Sample ID : 20074747WW14	**Analyses :** VOCs, METALS, SVOCs, EXPLOSIVES	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses:	8
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

EXPLOSIVES

Metals Filtered : Y (N)

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1310	29.53	150mL	0.0	23.8	1790	6.63	0.97	101.3	2.56
1313	29.75	150mL	0.45	23.4	1842	6.67	0.49	93.2	2.72
1316	29.78	150mL	0.90	23.2	1846	6.68	0.50	87.8	2.81
1319	29.80	150mL	1.35	23.2	1828	6.70	0.47	85.3	3.21
1322	29.84	150mL	1.80	23.2	1832	6.70	0.43	84.9	2.48
1325	29.82	150mL	2.25	23.5	1821	6.71	0.43	81.0	3.21
1328	29.82	150mL	2.70	23.1	1820	6.72	0.39	79.1	2.64
1331	29.83	150mL	3.15	23.5	1810	6.74	0.39	76.8	2.60
1334	29.76	150mL	3.60	25.1	1811	6.74	0.41	74.8	2.52
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1350 | Sampler's Signature: [signature] | Checked by : PW/EN

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Page : ~~1 of 2~~ END
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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW35	Samplers : END
Date : 07/21/2018	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO				
Water Level Meter : Geotech				
Parameter Meter : YSI 556				
Turbidity Meter: Geotech				
Casing Diameter : 4" ID	Initial Water Level : 20.95' btoc	Final Water Level : 21.50' btoc	Total Well Depth : 47'	Purge Volume (Total): 3.5 L

Sample ID : 210747WW35	**Analyses :**	**# of Bottles**
QC Samples: (FD) FS RB (MS/MSD)	Analyses: VOCs	~~END~~ 12
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks ~~rust~~ colored material in water

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0908	21.13	160	1.0	21.2	6804	7.11	1.95	-57.2	13.4
0911	21.30	160	1.5	21.1	6797	7.00	0.89	-59.0	10.0
0914	21.34	160	2.0	21.0	6795	6.96	0.66	-59.2	9.94
0917	21.39	160	2.5	21.1	6789	6.94	0.56	-59.1	10.3
0920	21.46	160	3.0	21.1	6797	6.91	0.51	-58.5	10.5
0923	21.50	160	3.5	21.2	6795	6.89	0.60	-58.8	10.8
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 0930	Sampler's Signature:	Checked by : PW

DUP-03 1200

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW56R	Samplers : EN
Date : 07/21/18	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO
Water Level Meter : Geotech
Parameter Meter : YSI 556
Turbidity Meter: Geotech

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4" ID	24.68' btoc	25.06' btoc	34.5'	4.5L

Sample ID : 2107LHSMW56R	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, explosives	5
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1057	24.92	150	0.5	22.4	1618	7.26	1.24	5.2	19.1
1100	24.96	150	1.0	21.9	1608	7.06	0.69	13.8	10.1
1103	24.98	150	1.5	21.9	1606	6.95	0.52	16.2	9.36
1106	25.01	150	2.0	21.7	1608	6.89	0.44	17.4	9.05
1109	25.05	150	2.5	21.7	1605	6.86	0.38	18.5	7.29
1112	25.03	150	3.0	21.6	1608	6.83	0.35	19.8	5.29
1115	25.04	150	3.5	21.6	1606	6.81	0.32	20.4	5.20
1118	25.08	150	4.0	21.6	1605	6.80	0.31	21.6	4.34
1121	25.06	150	4.5	21.8	1603	6.79	0.31	21.0	4.94
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1130	Sampler's Signature:	Checked by : EW

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW54	Samplers : EN
Date : 07/21/2018	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI 556	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4" ID	19.59' btoc	19.85' btoc	42.2'	3.5 L

Sample ID : 2107LHSMW54	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, perchlorate	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks non-working lock

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1300	19.80	160	0.5	21.2	1451	7.17	0.50	57.0	13.7
1303	19.83	160	1.0	21.3	1453	7.08	0.39	57.7	7.36
1306	19.83	160	1.5	21.1	1453	7.08	0.36	58.0	7.21
1309	19.84	160	2.0	21.1	1453	7.05	0.35	58.9	5.64
1312	19.86	160	2.5	21.1	1456	7.02	0.34	60.0	4.26
1315	19.87	160	3.0	21.1	1454	7.02	0.33	61.6	5.38
1318	19.85	160	3.5	21.1	1453	6.99	0.30	62.0	5.71
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1330	Sampler's Signature:	Checked by : PW

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW45	Samplers : EN
Date : 07/21/2018	Project : LHAAP-47

Equipment

Pump : GeoCamTrol PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI 556	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4" ID	27.50' btoc	27.65' btoc	35.5'	3.5 L

Sample ID : 2107LHSMW45	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, SVOCs	5
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SAA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1500	27.59	150	0.5	22.7	3491	8.45	1.28	246.1	0.02
1503	27.66	150	1.0	22.7	3488	8.27	1.13	268.5	0.02
1506	27.67	150	1.5	22.7	3484	8.15	1.07	277.5	0.02
1509	27.67	150	2.0	~~22.6~~	3485	8.13	1.06	290.1	0.02
1512	27.69	150	2.5	22.4	3477	8.09	1.05	300.5	0.02
1515	27.64	150	3.0	22.3	3481	8.06	1.06	301.2	0.02
1518	27.65	150	3.5	22.3	3483	8.04	1.10	310.8	0.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1530 | Sampler's Signature: | Checked by : PW

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW34	Samplers : PJW
Date : 7/21/18	Project : LHAAP-47 RSI

Equipment

Pump : GeoTech Bladder
Water Level Meter : GeoTech
Parameter Meter : YSI 556
Turbidity Meter: GeoTech

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	BTOC 20.6'	BTOC 21'	43'	5.65 L

Sample ID : 210747WW34	Analyses :	# of Bottles
~~QC Samples: FD FS RB MS/MSD~~	Analyses: VOCs	3
Full Sample: (Y) N		
Partial Sample: Y N	Analyses Collected: SAA	

Well Conditions, Remarks

Pump Depth - 38' BTOC Tested turbidity meter = pass

Metals Filtered : Y / N

Time	Depth to Water BTOC (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1110	20.6	150	150	26.2	1280	7.14	8.1	117.3	<2.02
1115	20.75	–	900	22.0	1255	6.97	8.13	118.1	<2.02
1120	20.95	–	1650	21.5	1253	~~6.98~~	7.7	119.5	<2.02
1125	20.95	130	2400	21.3	1252	6.93	7.45	120.1	<2.02
1130	21.0	–	3050	21.4	1252	6.94	7.27	119.0	<2.02
1135	21.0	–	3700	21.4	1251	6.93	7.21	118.7	<2.02
1140	21.0	–	4350	21.4	1246	6.93	7.2	119.1	<2.02
1145	21.0	–	5000	21.4	1243	6.93	6.62	119.2	<2.02
1150	21.0	–	5650	21.4	1240	6.93	6.6	118.9	<2.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1155	Sampler's Signature:	Checked by : EN

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW33	Samplers : PJW
Date : 7/21/18	Project : LHAAP-47 PSI

Equipment

Pump : GeoTech Bladder	
Water Level Meter : GeoTech	
Parameter Meter : YSI 556	
Turbidity Meter: GeoTech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	12.9' BTOC	12.9 BTOC	35'	4.65 L

Sample ID : 210747WW33	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs	3
Full Sample: (Y) N		
Partial Sample: Y N	Analyses Collected: SAA	

Well Conditions, Remarks

Pump Depth = 30' BTOC

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0925	12.9	150	~~450~~	21.3	1730	5.49	5.33	126.1	<2.02
0928	12.9	–	600	20.5	1895	5.5	5.2	113.4	<2.02
0931	12.9	–	1050	20.4	1897	5.4	5.5	111.3	<2.02
0934	12.9	–	1500	20.8	1894	5.5	5.23	110.5	<2.02
0937	12.9	–	1950	20.3	1890	5.5	5.09	112.2	<2.02
0940	12.9	–	2400	20.4	1882	5.5	5.0	112.1	<2.02
0945	12.9	–	2850	20.4	1868	5.5	4.87	112.7	<2.02
0950	12.9	–	3300	20.1	1853	5.5	0.31	114.1	<2.02
0955	12.9	–	3750	20.4	1833	5.5	0.3	116.2	<2.02
1000	12.9	–	4200	20.3	1822	5.5	0.3	117.0	<2.02
1005	12.9	–	4650	20.3	1785	5.5	0.3	117.7	<2.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1010 Sampler's Signature: [signature] Checked by : EN

HDR

Low - Flow Groundwater Sampling Data Sheet

Well ID: LHSMW41		Samplers: PDW		
Date: 7/21/18		Project: LHAAP-47 PSI		
Equipment				
Pump: GeoTech Bladder				
Water Level Meter: GeoTech				
Parameter Meter: YSI 556				
Turbidity Meter: GeoTech				
Casing Diameter: 4"	Initial Water Level: 27.1 BTOC	Final Water Level: 27.7 BTOC	Total Well Depth: 36'	Purge Volume (Total): 6.63L

Sample ID: 2107 LHSMW41	**Analyses:**	**# of Bottles**
~~QC Samples: FD FS RB MS/MSD~~	Analyses: VOCs	3
Full Sample: Y N		
Partial Sample: Y N	Analyses Collected: SAA	

Well Conditions, Remarks

Pump Depth = 31' BTOC

Cal tested turbidity water = passed

Metals Filtered: Y / N

Time	Depth to Water BTOC (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1325	27.1	130	130	22.8	2897	6.83	4.28	148.3	<2.02
1330	27.6	~	780	22.5	2892	6.81	3.66	146.5	<2.02
1335	27.7	~	1430	22.7	2891	6.81	3.27	143.5	<2.02
1340	27.7	~	2080	22.8	2886	6.82	2.96	139.5	<2.02
1345	27.7	~	2730	22.6	2898	6.82	2.70	135.4	<2.02
1350	27.7	~	3380	22.8	2893	6.83	2.52	131.4	<2.02
1355	27.7	~	4030	22.8	2892	6.84	2.47	128.4	<2.02
1400	27.7	~	4680	22.7	2887	6.84	2.43	127.6	<2.02
1405	27.7	~	5330	22.7	2880	6.86	2.24	125.8	<2.02
1410	27.7	~	5980	22.7	2878	6.85	2.2	122.3	<2.02
1415	27.7	~	6630	22.7	2877	6.85	2.21	122	<2.02
Stabilization Criteria:				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time: 1415 | Sampler's Signature: [signature] | Checked by: EN

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW42R	Samplers : JM
Date : 07/21/2018	Project : LHAAP-47PSI

Equipment

Pump : GEOTECH BLADDER PUMP

Water Level Meter : GEOTECH #5886

Parameter Meter : GEOTECH PRO+4M4076

Turbidity Meter: GEOTECH #6120

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	27.97' BTOC	28.10 BTOC	38.00'	4.50

Sample ID : 2107LHSMW42R	**Analyses :** PERCHLORATE, VOCs	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses:	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1125	27.97	150 mL	0.00	26.4	3138	6.61	1.53	68.8	0.02
1128	28.03	150 mL	0.45	24.5	3140	6.55	1.11	64.0	0.02
1131	28.04	150 mL	0.90	23.6	3153	6.57	0.88	61.5	0.06
1134	28.06	150 mL	1.35	23.6	3155	6.58	0.88	60.1	0.02
1137	28.07	150 mL	1.80	23.5	3155	6.56	0.51	58.0	0.02
1140	28.09	150 mL	2.25	23.5	3151	6.56	0.45	57.4	0.02
1143	28.08	150 mL	2.70	23.6	3159	6.56	0.43	55.3	0.02
1146	28.10	150 mL	3.15	23.4	3157	6.56	0.37	53.9	0.02
1149	28.09	150 mL	3.60	23.5	3153	6.57	0.38	52.1	0.02
1152	28.10	150 mL	4.05	23.8	3149	6.58	0.36	49.9	0.02
1155	28.10	150 mL	4.50	23.8	3154	6.59	0.38	49.4	0.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1200 Sampler's Signature: John Mc Checked by : PW/EN

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW19	Samplers : JM
Date : 07/21/2018	Project : LHAAP-47PSI

Equipment

Pump : GEOTECH BLADDER PUMP	
Water Level Meter : GEOTECH #5886	
Parameter Meter : GEOTECH PRO+4M4076	
Turbidity Meter: GEOTECH #6120	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	25.22' BTOC	~~0~~ JM 25.25 BTOC	61.7'	4.5L

Sample ID : 210747WW19	**Analyses :** PERCHLORATE, VOCs, METALS	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses:	5
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y (N)

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0900	25.22	100mL	0.3	22.1	2872	6.43	4.05	77.5	41.6
0903	25.26	100mL	0.6	21.4	2858	6.35	3.02	75.8	40.0
0906	25.24	100mL	0.9	21.4	2857	6.33	2.63	74.7	41.2
0909	25.26	100mL	1.2	21.6	2861	6.33	2.60	72.7	40.0
0912	25.26	100mL	1.5	21.3	2855	6.33	2.59	71.9	39.7
0915	25.27	100mL	1.8	21.3	2856	6.32	2.58	70.6	38.5
0918	25.26	100mL	2.1	21.5	2857	6.32	2.59	70.1	39.8
0921	25.24	100mL	2.4	21.6	2849	6.20	1.85	48.9	38.8
0924	25.24	100mL	2.7	21.7	2901	6.14	1.22	29.4	38.6
0927	25.26	100mL	3.0	21.7	2927	6.11	1.06	27.6	28.0
0930	25.24	100mL	3.3	21.8	2936	6.09	0.98	23.5	17.6
0933	25.24	100mL	3.6	21.8	2940	6.08	0.73	21.6	15.5
0936	25.25	100mL	3.9	21.9	2945	6.08	0.65	20.9	14.2
0939	25.25	100mL	4.2	22.0	2950	6.08	0.66	19.8	14.0
0942	25.25	100mL	4.5	22.1	2952	6.08	0.65	20.1	13.9
Stabilization Criteria :				±1°	±10%	±0.1	±10%	±10	±10% and under 50 NTUs

Sample Time : 0950 | Sampler's Signature: | Checked by : PW/EN

00916299

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Low - Flow Groundwater Sampling Data Sheet

Well ID : ~~210747WW26R~~ JTM 47WW26R			Samplers : JM	
Date : 07/21/2018			Project : LHAAP-47PSI	
Equipment				
Pump : GEOTECH BLADDER PUMP				
Water Level Meter : GEOTECH #5886				
Parameter Meter : GEOTECH PRO+4M4076				
Turbidity Meter: GEOTECH #6120				
Casing Diameter : 4"	Initial Water Level : 29.93' BTOC	Final Water Level : 31.58' BTOC	Total Well Depth : 39.3'	Purge Volume (Total): 1.5L
Sample ID : 210747WW26R		**Analyses :** PERCHLORATE		**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~		Analyses:		1
Full Sample: (Y) N				
Partial Sample: Y (N)		Analyses Collected: SAA		

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1435	29.93	100mL	0.3	24.4	2409	6.68	3.74	39.7	0.02
1438	31.05	100mL	0.6	21.5	2357	6.63	1.94	42.9	0.02
1441	31.54	100mL	0.9	21.7	2355	6.65	1.80	44.1	0.02
1444	31.57	100mL	1.2	21.4	2360	6.67	1.82	44.8	0.02
1447	31.58	100mL	1.5	21.3	2353	6.67	1.80	45.0	0.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1455 | Sampler's Signature: [signature] | Checked by : PW / EN

00916300

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LHSMW44		Samplers : JM		
Date : 07/22/2018		Project : LHAAP-47		
Equipment				
Pump : GEOTECH BLADDER PUMP				
Water Level Meter : GEOTECH #				
Parameter Meter : GEOTECH PRO+4M4076				
Turbidity Meter: GEOTECH #6120				
Casing Diameter : 4"	Initial Water Level : 26.95' BTOC	Final Water Level :	Total Well Depth : 35.50'	Purge Volume (Total):
Sample ID : 2207LHSMW44		**Analyses :** VOCs		**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~		Analyses:		3
Full Sample: (Y) N				
Partial Sample: Y (N)		Analyses Collected: SAA		

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1110	26.95	150mL	0.00	23.4	3769	7.10	3.40	96.3	0.02
1113	27.03	150mL	0.45	21.6	3755	6.98	1.06	91.6	0.02
1116	27.21	150mL	0.90	21.2	3756	6.96	1.05	85.2	0.02
1119	27.35	150mL	1.35	21.1	3755	6.96	1.05	82.6	0.02
1122	27.53	150mL	1.80	21.2	3755	6.96	1.04	79.3	0.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1130 | Sampler's Signature: [signature] | Checked by : PW/EN

00916301

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW38	Samplers : EN, JM
Date : 09/16/2018	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI ~~Geotech turbidity~~	
Turbidity Meter: Geotech turbidity	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
2"	23.18' btoc	23.25' btoc	60.01' btoc	1.2 L

Sample ID : 160947WW38	Analyses :	# of Bottles
~~QC Samples: FD FS RB MS/MSD~~	Analyses: VOCs, perchlorate, metals, SVOCs	9
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y (N)

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1240	23.23	50	0.2	27.3	1164	7.60	7.10	165.2	12.8
1243	23.23	50	0.3	25.8	1114	7.35	6.76	146.8	6.40
1246	23.23	50	0.5	26.1	1110	7.30	6.34	141.4	5.97
1249	23.23	50	0.6	25.6	1113	7.28	6.24	133.7	4.09
1252	23.23	50	0.7	25.4	1111	7.28	6.11	129.7	6.27
1255	23.23	50	0.9	25.6	1104	7.27	5.76	121.4	6.47
1258	23.25	50	1.1	25.5	1106	7.29	5.71	116.0	5.14
1301	23.25	50	1.2	25.6	1104	7.30	5.68	111.5	6.21
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1315	Sampler's Signature:	Checked by : JM

00916302

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW37		Samplers : EN, JM		
Date : 09/16/2018		Project : LHAAP-47		
Equipment				
Pump : GeoControl PRO				
Water Level Meter : GeoControl				
Parameter Meter : YSI				
Turbidity Meter: GeoControl				
Casing Diameter : 2"	Initial Water Level : 32.32' btoc	Final Water Level : 34.85' btoc	Total Well Depth : 69' btoc	Purge Volume (Total): 3.0 L
Sample ID : 160947WW37		**Analyses :** VOCs, metals, SVOCs		**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~		Analyses: VOCs, metals, SVOCs		8
Full Sample: (Y) N				
Partial Sample: Y (N)		Analyses Collected: ~~SAA~~		
Well Conditions, Remarks				

Metals Filtered : Y (N)

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1515	~~34~~.02	200	0.6	23.1	1516	7.86	~~87.3~~ EN	147.6	13.5
1518	34.19	150	1.0	23.4	1516	7.83	~~84.0~~ EN	154.2	16.0
1521	34.65	150	1.5	23.6	1516	7.82	7.08	145.2	9.67
1524	34.82	100	1.8	23.4	1513	7.83	7.06	142.4	7.35
1527	34.90	100	2.1	23.7	1513	7.85	6.74	139.2	7.80
1530	34.88	100	2.4	24.2	1514	7.87	6.66	135.7	5.36
1533	34.86	100	2.7	24.1	1516	7.90	6.64	128.2	2.49
1536	34.85	100	3.0	24.3	1514	7.90	6.62	126.7	1.97
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1540 | Sampler's Signature: | Checked by : JM

00916303

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW47	Samplers : EN, JM
Date : 09/17/18	Project : LHAAP-47

Equipment

Pump : GeoControl PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	25.11' btoc	25.90' btoc	55.45' btoc	3.7 L

Sample ID : 17047WW47	**Analyses :** VOCs, perchlorate	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, perchlorate	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SAA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0815	25.39	200	0.5	20.0	3801	9.37	~~5.18~~	119.1	2.80
0818	25.61	150	0.9	20.2	3814	9.33	4.40	115.6	2.87
0821	25.69	150	1.4	20.2	3837	9.26	4.25	111.1	3.29
0824	25.75	150	1.9	20.3	3859	9.17	4.10	108.8	2.47
0827	25.78	150	2.2	20.3	3880	9.10	4.09	105.7	2.15
0830	25.81	150	2.6	20.3	3903	9.00	3.89	101.7	2.17
0833	25.85	150	3.0	20.3	3915	8.93	3.65	99.1	0.82
0836	25.88	150	3.3	20.4	3920	8.87	3.58	98.1	1.75
0839	25.90	150	3.7	20.3	3932	8.82	3.68	94.9	2.29
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 0840	Sampler's Signature:	Checked by : JM

DUP-04

00916304

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW44	Samplers : EN, JM
Date : 09/17/2018	Project : LHAAP-47

Equipment

Pump : Geocontrol PR6	
Water Level Meter : Geotech	
Parameter Meter : YSI	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	26.39' btoc	27.05' btoc	62.00' btoc	2.8 L

Sample ID : 1709 47WW44	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, perchlorate	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SAA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0910	26.61	150	0.5	21.5	2907	7.02	7.89	-54.0	0.96
0913	26.74	150	1.0	21.1	2909	6.86	7.73	-45.8	0.65
0916	26.83	150	1.4	21.2	2905	6.83	7.45	-41.6	0.07
0919	26.94	150	1.9	21.5	2898	6.82	7.33	-39.9	0.02
0922	27.01	150	2.4	21.4	2902	6.82	7.34	-38.9	0.02
0925	27.05	150	2.8	21.4	2902	6.82	7.28	-38.7	0.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 0940 | Sampler's Signature: | Checked by : JM

00916305

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW45	Samplers : EN, JM
Date : 09/17/2018	Project : LHAAP-47

Equipment

Pump : GeoCastro PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	19.43' btoc	20.34' btoc	50.49' btoc	2.7L

Sample ID : 190747WW45	**Analyses :**	**# of Bottles**
QC Samples: (FD) FS RB (MS/MSD)	Analyses: VOCs, perchlorate	16
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Collect DUP-04 here. Sample time 1130

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1005	19.34	150	0.5	21.6	1924	11.20	4.40	27.1	10.1
1008	19.51	150	0.9	21.2	1917	11.17	3.70	27.1	3.75
1011	19.72	100	1.2	21.0	1916	11.14	3.59	26.4	4.16
1014	19.96	100	1.5	20.9	1913	11.14	3.29	23.4	4.87
1017	20.11	100	1.8	20.8	1913	11.15	3.41	20.7	1.61
1020	20.23	100	2.1	20.9	1912	11.16	3.24	18.2	2.57
1023	20.38	100	2.4	21.1	1910	11.18	3.22	15.2	1.18
1026	20.34	100	2.7	21.4	1909	11.20	3.23	13.8	1.05
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1050	Sampler's Signature:	Checked by : JM

00916306

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW46	Samplers : EN, JM
Date : 09/17/18	Project : LHAAP-47

Equipment

Pump : Grocastro	DRO
Water Level Meter :	Geotech
Parameter Meter :	YSI
Turbidity Meter:	Geotech

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	21.25' btoc	21.41' btoc	57.90' btoc	2.9 L

Sample ID : 17094 7WW46	**Analyses :**	**# of Bottles**
QC Samples: ~~FD~~ ~~FS~~ RB ~~MS/MSD~~	Analyses: VOCs, perchlorate	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SAA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1100	21.34	100	0.5	24.8	1969	7.58	5.65	36.2	4.05
1103	21.37	100	0.8	23.8	2302	7.30	5.64	30.6	0.95
1106	21.38	100	1.1	23.7	2360	7.24	5.30	28.3	0.87
1109	21.40	100	1.4	23.4	2370	7.21	4.97	27.2	1.04
1112	21.40	100	1.7	23.3	2373	7.20	4.74	27.0	0.61
1115	21.40	100	2.0	23.4	2374	7.20	4.42	25.1	0.67
1118	21.40	100	2.3	23.5	2373	7.20	3.01	23.3	0.80
1121	21.41	100	2.6	23.2	2377	7.21	2.90	21.3	0.70
1124	21.41	100	2.9	23.2	2377	7.21	2.94	21.0	0.52
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1135 | Sampler's Signature: | Checked by : JM

00916307

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Low - Flow Groundwater Sampling Data Sheet

Well ID : LTWW43	Samplers : BN JM
Date : 09/17/2018	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	25.52' btoc	25.93' btoc	35.39' btoc	2.5 L

Sample ID :	Analyses :	# of Bottles
QC Samples: ~~FD FS RB MS/MSD~~ →	Analyses: VOCs, perchlorate, explosives	6
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (L/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1245	25.74	130	0.5	24.5	3705	7.09	4.98	77.9	6.50
1248	25.80	130	0.9	23.9	3687	7.08	5.17	56.5	0.28
1251	25.82	130	1.3	24.1	3683	7.07	5.00	46.6	0.02
1254	25.88	130	1.7	24.3	3689	7.07	5.34	35.6	0.47
1257	25.90	130	2.1	24.3	3688	7.08	5.22	34.6	0.40
1300	25.93	130	2.5	24.3	3689	7.08	5.27	34.5	0.25
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1315	Sampler's Signature:	Checked by : JM

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW40	Samplers : EN, JM
Date : 09/17/18	Project : LHAAP-47

Equipment

Pump : Geocontrol				
Water Level Meter : Geotech				
Parameter Meter : YSI				
Turbidity Meter: Geotech				
Casing Diameter : 4"	Initial Water Level : 23.74' btoc	Final Water Level : 23.86' btoc	Total Well Depth : 42.39' btoc	Purge Volume (Total): 4.0 L

Sample ID : 20947WW40	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: Perchlorate	1
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SAA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate mL/min	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1425	23.83	150	0.5	23.2	1327	6.60	2.07	25.6	1.83
1428	23.85	150	1.0	23.2	1337	6.57	2.07	23.1	1.79
1431	23.85	150	1.4	23.1	1347	6.55	1.36	15.1	1.83
1434	23.85	150	1.9	23.2	1368	6.56	1.22	10.4	1.69
1437	23.85	150	2.3	23.2	1390	6.56	1.14	2.7	1.34
1440	23.85	150	2.7	23.1	144	6.58	1.03	-6.1	1.59
1443	23.84	150	3.1	23.0	1428	6.59	0.96	-17.0	1.80
1446	23.84	150	3.5	22.8	1443	6.58	0.91	-19.2	0.23
1449	23.86	150	4.0	22.8	1453	6.58	1.02	-20.5	0.98
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1455	Sampler's Signature:	Checked by : JM

Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW41	Samplers : BN, JM
Date : 09/17/18	Project : LHAAP-47

Equipment

Pump : Geo control PRO				
Water Level Meter : Geotech				
Parameter Meter : YSI				
Turbidity Meter: Geotech				
Casing Diameter : 4"	Initial Water Level : 28.09' btoc	Final Water Level : 28.54' btoc	Total Well Depth : 42.39' btoc	Purge Volume (Total): 2.3L

Sample ID : 170947WW41	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, perchlorate	4
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: ~~SA~~	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1515	28.27	120	0.5	25.3	3679	6.93	7.38	69.2	4.95
1518	28.41	120	0.9	24.5	3673	6.98	6.88	65.0	5.17
1521	28.44	120	1.3	24.1	3652	6.83	6.67	65.1	3.77
1524	28.50	120	1.6	24.3	3657	6.82	6.30	64.4	4.44
1527	28.51	120	1.9	24.0	3658	6.83	6.40	63.8	3.55
1530	28.54	120	2.3	24.0	3659	6.82	6.25	64.4	
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1550	Sampler's Signature:	Checked by : JM

00916310

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Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW42	Samplers : EN, JM
Date : 09/18/18	Project : LHAAP-47

Equipment

Pump : Geocontrol PRO	
Water Level Meter : Geotech	
Parameter Meter : YSI	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	22.19' btoc	22.32' btoc	43.01' btoc	2.5 L

Sample ID : 180947WW42	Analyses :	# of Bottles
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, explosives	5
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y / N

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
0850	22.31	130	0.5	22.5	760	7.61	8.02	50.6	0.02
0853	22.33	130	0.9	22.2	760	7.52	7.87	48.4	0.02
0856	22.35	130	1.3	22.2	759	7.48	7.76	47.4	0.02
0859	22.35	130	1.7	22.2	759	7.45	7.68	44.4	0.02
0902	22.34	130	2.1	22.2	758	7.43	7.60	41.9	0.02
0905	22.32	130	2.5	22.2	758	7.44	7.58	39.0	0.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 0930	Sampler's Signature:	Checked by : JM

00916311

Page : 1 of 1

Low - Flow Groundwater Sampling Data Sheet

Well ID : 47WW09	Samplers : EN, JM
Date : 09/18/18	Project : LHAAP-47

Equipment

Pump : Geocontrol RRO	
Water Level Meter : Geotech	
Parameter Meter : YSI	
Turbidity Meter: Geotech	

Casing Diameter :	Initial Water Level :	Final Water Level :	Total Well Depth :	Purge Volume (Total):
4"	27.75' btoc	28.68' btoc	41.25' btoc	2.4 L

Sample ID : 180947WW09	**Analyses :**	**# of Bottles**
QC Samples: ~~FD FS RB MS/MSD~~	Analyses: VOCs, perchlorate, metals, SVOCs, explosives	11
Full Sample: (Y) N		
Partial Sample: Y (N)	Analyses Collected: SAA	

Well Conditions, Remarks

Metals Filtered : Y (N)

Time	Depth to Water (ft)	Pumping Rate (mL/min)	Purge Volume (L)	Temp. (°C)	Conductivity (uS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)
1005	28.23	100	0.3	23.1	3190	7.60	5.87	77.7	0.02
1008	28.00	100	0.6	22.0	3179	7.52	5.95	70.0	0.02
1011	28.19	100	0.9	22.2	3176	7.49	5.75	63.8	0.02
1014	28.15	100	1.2	22.3	3175	7.48	5.67	55.1	0.02
1017	28.29	100	1.5	22.3	3179	7.48	5.57	51.4	0.02
1020	28.40	100	1.8	22.2	3177	7.48	5.48	40.2	0.02
1023	28.51	100	2.1	22.2	3174	7.48	5.29	39.2	0.02
1026	28.68	100	2.4	22.3	3173	7.48	5.19	37.2	0.02
Stabilization Criteria :				± 1°	± 10%	± 0.1	± 10%	± 10	± 10% and under 50 NTUs

Sample Time : 1040	Sampler's Signature:	Checked by : JM

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Data Validation Reports

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DATA VALIDATION REPORT

Volatile Organic Compounds (VOCs) by USEPA SW-846 Method 8260B
Perchlorate by USEPA SW-846 Method 6850
Semivolatile Organic Compounds (SVOCs) by USEPA SW-846 Method 8270C
Herbicides by USEPA SW-846 Method 8151A
Explosives by USEPA Method 8330B
Metals by USEPA SW-846 Methods 6010C and 6020

Project: USACE Longhorn Army Ammunition Plant (LHAAP), Texas
July 2018
Project/Task Number: 10097916
Sample Data Package: L18071307, L18071452
Laboratory: Microbac Labs, Marietta, Ohio
Sample Matrix: Groundwater
Sampling Dates: July 2018
Validation Guidelines: Project QAPP *(Final Quality Assurance Project Plan for Longhorn Army Ammunition Plant, Karnack, Texas [July 2014]*); United States Environmental Protection Agency (USEPA) *Test Methods for Evaluating Solid Waste, Physical/Chemical Meth*ods, *3rd edition* (SW-846); *National Functional Guidelines for Inorganic Superfund Data Review (USEPA, September 2016); National Functional Guidelines for Organic Superfund Data Review (USEPA, September 2016)* and professional judgment
Validation Level: Stage 2BVM (100% of data), Stage 3VM (10% of data)
Data Reviewer: Lynn K. Lutz, HDR

Sample ID	Lab ID	Matrix	VOCs	Per-chlorate	SVOCs	Herbs	Explo-sives	Metals
1907LHSMW46R	L18071307-01	GW	X	X	X	X		X
190747WW08R	L18071307-02	GW	X					X
1907LHSMW43R	L18071307-03	GW	X	X				
190747WW11R	L18071307-04	GW		X			X	
190747WW32	L18071307-05	GW	X					
190747WW39	L18071307-06	GW	X	X				
190747WW29	L18071307-07	GW	X	X				
190747WW31	L18071307-08	GW	X					
2007LHSMW60	L18071307-09	GW	X	X	X	X	X	X
2007LHSMW60MS	L18071307-10	GW	X	X	X	X	X	X
2007LHSMW60MSD	L18071307-11	GW	X	X	X	X	X	X
DUP-01	L18071307-12	GW	X	X	X	X	X	X
2007LHSMW55R	L18071307-13	GW	X	X				
DUP-02	L18071307-14	GW	X	X				
200747WW06	L18071307-15	GW						X
200747WW14	L18071307-16	GW	X		X	X	X	X
TB-01	L18071307-17	QC Water	X					
200747WW23	L18071307-18	GW	X	X				
200747WW25R	L18071307-19	GW	X					
210747WW35	L18071452-01	GW	X					
210747WW35MS	L18071452-02	GW	X					
210747WW35MSD	L18071452-03	GW	X					
DUP-03	L18071452-04	GW	X					
2107LHSMW56R	L18071452-05	GW	X				X	

Sample ID	Lab ID	Matrix	VOCs	Per-chlorate	SVOCs	Herbs	Explo-sives	Metals
2107LHSMW54	L18071452-06	GW	X	X				
2107LHSMW45	L18071452-07	GW	X		X	X		
210747WW33	L18071452-08	GW	X					
210747WW34	L18071452-09	GW	X					
2107LHSMW41	L18071452-10	GW	X					
210747WW19	L18071452-11	GW	X	X				X
2107LHSMW42R	L18071452-12	GW	X	X				
210747WW26R	L18071452-13	GW		X				
TB-02	L18071452-14	QC Water	X					
EB-01	L18071452-15	QC Water	X	X	X	X	X	X
2207LHSMW44	L18071452-16	GW	X					

SUMMARY

One hundred percent of the data underwent Stage 2BVM level validation. Ten percent of the data underwent Stage 3VM level validation.

Laboratory data were acceptable with qualification as noted below. No data were rejected. Completeness was 100%, which met the goal of 90% for the project.

I. SAMPLE RECEIPT / CHAIN OF CUSTODY

The chains of custody (COC) were filled out and signed. Samples were received within the correct temperature range (between 0°C and 6°C). No qualification was required.

II. SAMPLES ANALYZED

All planned samples were collected and all scheduled analyses were performed. The correct analyte lists were reported. No qualification was required.

VOCs: Samples were analyzed by USEPA SW-846 Method 8260B. Results are reported in µg/L.

Perchlorate: Samples were analyzed by USEPA Method SW-846 6850. Results are reported in µg/L.

SVOCs: Samples were analyzed by USEPA SW-846 Method 8270C. Only bis(2-ethylhexyl)phthalate was requested and reported. Results are reported in µg/L. Sample 210747WW19 was incorrectly marked on the COC for SVOC analysis; this analysis was not performed per instructions from the Project Manager.

Herbicides: Samples were analyzed by USEPA SW-846 Method 8151A. Only pentachlorophenol (PCP) was requested and reported. Results are reported in µg/L. Herbicides were not specifically indicated on the COCs. Pentachlorophenol was analyzed by the herbicide method SW8151A rather than the SVOC method 8270C in order to achieve a limit of quantitation (LOQ) below the regulatory limit.

Explosives: Samples were analyzed by USEPA SW-846 Method 8330B. Only 2,4,6-trinitrotoluene (246TNT), 2,4-dinitrotoluene (24DNT) and 2,6-dinitrotoluene (26DNT) were requested and reported. Results are reported in µg/L.

Metals: Samples were analyzed by USEPA SW-846 Method 6010C and 6020. Results are reported in mg/L. Aluminum, chromium, cobalt, manganese, nickel, silver, strontium, tin and vanadium were analyzed by method WS6010C. Antimony, arsenic, cadmium and thallium were analyzed by method SW6020.

III. HOLDING TIMES AND PRESERVATION

All holding time criteria were met and no qualification was required except as noted below.

VOCs: Samples were analyzed within 14 days of collection.

Both vials of TB-02 contained headspace greater than 6 millimeters, and results for this sample have been qualified as non-detect estimated (UJ); there were no VOCs detected in this sample.

Samples 190747WW31 and 2207LHSMW44 were at pH 4 and pH 5 at the time of analysis, above the required pH of 2. These samples were analyzed past the seven day hold time for unpreserved samples. All results in these two samples have been qualified as non-detect estimated (UJ) or estimated (J).

Perchlorate: Samples were analyzed within 28 days of collection. No qualification was required.

SVOCs: Samples were extracted within seven days of collection and analyzed within 40 days of extraction.

Herbicides: Samples were extracted three to five days after the seven day holding time due to a communication issue with the lab. The herbicide analysis was not specifically indicated on the COCs because the original plan was to analyze PCP as an SVOC. The lab indicated that they could not meet the required LOQ with the SVOC analysis and would need to analyze by Method 8151A. This information apparently did not get disseminated to the login personnel, and the herbicide prep was not begun until after the holding time had expired. All sample results have been qualified as non-detect estimated (UJ) or estimated with a possible low bias (J-).

Explosives: Samples were extracted within seven days of collection and analyzed within 40 days of extraction.

Metals: Samples were analyzed within 180 days of collection.

IV. BLANKS

METHOD BLANKS

Target analytes were not detected in method blanks except as noted below.

VOCs: VOCs were not detected in the MBs. No qualification was required.

Perchlorate: Perchlorate was not detected in the MBs. No qualification was required.

SVOCs: Bis(2-ethylhexyl)phthalate was not detected in the method blanks. No qualification was required.

Herbicides: PCP was not detected in the MBs. No qualification was required.

Explosives: Explosives were not detected in the method blanks. No qualification was required.

Metals: Manganese was detected at a trace level in one MB. Manganese in the equipment blank (EB-01) was detected at a similar concentration and has been qualified as estimated with a possible high bias (J+).

TRIP BLANKS

VOCs: Two trip blanks were collected (TB-01 and TB-02). Acetone was detected in TB-01 at a trace level (2.99 µg/L); reanalysis found acetone at 3.03 µg/L. Acetone in three associated samples (1907LHSMW46R, 200747WW23 and 200747WW25R) was detected at less than 10 times the blank and has been qualified as estimated with a possible high bias (J+).

Both vials of TB-02 contained headspace greater than 6 millimeters, and results for this sample have been qualified as non-detect estimated (UJ); there were no VOCs detected in this sample.

Perchlorate: Not applicable.

SVOCs: Not applicable.

Herbicides: Not applicable.

Explosives: Not applicable.

Metals: Not applicable.

EQUIPMENT RINSE BLANK

One equipment rinse blank (EB-01) was collected. Target analytes were generally not detected except as noted below.

VOCs: Acetone was detected in EB-01 at a trace level (4.86 µg/L). Acetone in two associated samples (210747WW33 and 2107LHSMW41) was detected at less than 10 times the blank and has been qualified as estimated with a possible high bias (J+).

Perchlorate: Perchlorate was not detected in EB-01. No qualification was required.

SVOCs: Bis(2-ethylhexyl)phthalate was not detected in EB-01. No qualification was required.

Herbicides: PCP was not detected in EB-01. No qualification was required.

Explosives: Explosives were not detected in EB-01. No qualification was required.

Metals: Manganese was detected in EB-01 at a trace level. Manganese in all the samples was at greater than ten times the blank concentration. No qualification was required.

INITIAL AND CONTINUING CALIBRATION BLANKS (ICBs and CCBs)

VOCs: Not applicable.

Perchlorate: Perchlorate was not detected in the CCBs. No qualification was required.

SVOCs: Not applicable.

Herbicides: Not applicable.

Explosives: Not applicable.

Metals: Silver was detected at a trace level in one CCB. Silver in the associated field samples was non-detect. No qualification was required.

V. LABORATORY CONTROL SAMPLES (LCS)

Recoveries and relative percent differences (RPDs) were generally within control limits except as noted below.

VOCs: Recoveries and RPDs were within control limits. No qualification was required.

Perchlorate: Recoveries were within control limits. No qualification was required.

SVOCs: Recoveries and RPDs were within control limits. No qualification was required.

Herbicides: Recoveries were within control limits. No qualification was required.

Explosives: All recoveries were within control limits. No qualification was required.

Metals: All recoveries were within control limits. No qualification was required.

VI. MATRIX SPIKE / MATRIX SPIKE DUPLICATE (MS/MSD)

VOCs: Samples 2007LHSMW60 and 210747WW35 were designated on the COCs for MS/MSD analysis. All recoveries and RPDs were within control limits. No qualification was required.

Perchlorate: Sample 2007LHSMW60 was designated on the COC for MS/MSD analysis. The sample concentration of 33,000 µg/L was well above the spike of 0.2 µg/L, and recoveries were not evaluated. The RPD was within control limits. No qualification was required.

SVOCs: Sample 2007LHSMW60 was designated on the COC for MS/MSD analysis. All recoveries and RPDs were within control limits. No qualification was required.

Herbicides: Sample 2007LHSMW60 was designated on the COC for MS/MSD analysis. All recoveries and RPDs were within control limits. No qualification was required.

Explosives: Sample 2007LHSMW60 was designated on the COC for MS/MSD analysis. All recoveries and RPDs were within control limits. No qualification was required.

Metals: Sample 2007LHSMW60 was designated on the COC for MS/MSD analysis. The MSD recovery of nickel at 86.6% was below the control limits of 88-113%. Nickel was detected in the parent sample and has been qualified as estimated (J).

VI. DILUTION TEST AND POST DIGESTION SPIKE (PDS)

A dilution test was performed for analytes detected at least 50 times the concentration of the MRL, and results agreed within ten percent. A post digestion spike (PDS) was performed on samples and the recoveries were between 80 and 120 percent except as noted below. These tests are applicable only to metals by SW6010C and SW6020.

VOCs: Not applicable.

Perchlorate: Not applicable.

SVOCs: Not applicable.

Herbicides: Not applicable.

Explosives: Not applicable.

Metals: The dilution test and PDS were performed on sample EB-01. All results were within control limits.

VIII. FIELD DUPLICATES

Field duplicate (FD) samples were collected as shown in the table below. Control limits listed in the QAPP were used.

Field Duplicate Sample	Parent Sample
DUP-01	2007LHSMW60 (all analyses)
DUP-02	2007LHSMW55R (VOCs, perchlorate)
DUP-03	210747WW35 (VOCs only)

VOCs: Trichloroethene (TCE) in 210747WW35 was non-detect with an LOQ of 1.00 µg/L and a DL of 0.25 µg/L. TCE in DUP-03 was detected above the LOQ, at 1.23 µg/L. These results have been qualified as non-detect estimated (UJ) and estimated (J), respectively. The qualified results were below the cleanup level of 5 µg/L and are fully usable.

Perchlorate: Results were within the control limits. No qualification was required.

SVOCs: Results were within the control limits. No qualification was required.

Herbicides: Results were within the control limits. No qualification was required.

Explosives: Results were within the control limits. No qualification was required.

Metals: Results were within the control limits. No qualification was required.

IX. LABORATORY DUPLICATES

Laboratory duplicate (LD) analyses were not performed on any samples from this project.

X. INSTRUMENT CALIBRATION

INITIAL CALIBRATION

VOCs: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

Perchlorate: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

SVOCs: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

Herbicides: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

Explosives: The calibration curve included a standard at the LOQ. Calibration requirements were met. No qualification was required.

Metals: The calibration curve included a standard at the LOQ. Calibration requirements were met. No qualification was required.

INITIAL CALIBRATION VERIFICATION (ICV)
VOCs: ICV results were within the required limits. No qualification was required.

Perchlorate: ICV results were within the required limits. No qualification was required.

SVOCs: ICV results were within the required limits. No qualification was required.

Herbicides: ICV results were within the required limits. No qualification was required.

Explosives: ICV results were within the required limits. No qualification was required.

Metals: ICV results were within the required limits. No qualification was required.

CONTINUING CALIBRATION VERIFICATION (CCV)
VOCs: The recovery of 1,1-dichloroethene in one QCMRL standard at 159% was above the required limits of 50-150%. Concentrations of 1,1-dichloroethene in two samples (200747WW14 and 2107LHSMW45) were near the LOQ (MRL) and these results have been qualified as estimated with a possible high bias (J+). Other sample results were either non-detect or detected at greater than 10 times the standard concentration, and no qualification was required. The qualified sample concentrations of 3.39 µg/L and 5.37 µg/L were below the MCL/cleanup level of 7 µg/L and are fully usable.

Perchlorate: CCV results were within the required limits. No qualification was required.

SVOCs: CCV results were within the required limits. No qualification was required.

Herbicides: CCV results were within the required limits. No qualification was required.

Explosives: CCV results were within the required limits. No qualification was required.

Metals: The recoveries of chromium in two QCMRL standards at 1127% and silver at 123% and 126% were above the required limits of 80-120%. Concentrations of these analytes in the samples were either non-detect or detected at greater than 10 times the standard concentration, and no qualification was required.

XI. SURROGATES, INTERNAL STANDARDS AND ION RATIOS

VOCs: Internal standard areas and retention times were within required limits. No qualification was required.

The recoveries of the surrogate dibromofluoromethane at 124% was above the control limits of 80-119% in samples 200747WW25R. The recoveries of the other three surrogates were within control limits, and no qualification was required.

Perchlorate: The m/z 83/85 ratios were within the acceptable range of 2.3-3.8 for detected results. No qualification was required.

SVOCs: Internal standard areas and retention times were within required limits. Surrogate recoveries were within control limits. No qualification was required.

Herbicides: Surrogate recoveries were within control limits. No qualification was required.

Explosives: Surrogate recoveries were within control limits. No qualification was required.

Metals: Internal standard results were within required limits. No qualification was required.

XII. INTERFERENCE CHECK SAMPLES

Interference check sample solutions ICSA and ICSAB were analyzed (methods 6010C and 6020 only).

VOCs: Not applicable.

Perchlorate: Not applicable.

SVOCs: Not applicable.

Herbicides: Not applicable.

Explosives: Not applicable.

Metals: Results were within control limits. No qualification was required.

XIII. SAMPLE LIMITS OF QUANTITATION (LOQs)

Limits of quantitation (LOQs) should be less than the applicable cleanup levels as listed in the project QAPP.

VOCs: LOQs were below the groundwater MCLs/cleanup levels.

Perchlorate: LOQs were below the groundwater MCLs/cleanup levels.

SVOCs: The nominal LOQ of 10 µg/L was above the MCL/cleanup level of 6 µg/L. However, the detection limit (DL) of 3 µg/L was below the MCL/cleanup level, and the lab reported down to the DL.

Herbicides: Pentachlorophenol was analyzed by the herbicide method SW8151A rather than the SVOC method 8270C in order to achieve a limit of quantitation (LOQ) below the regulatory limit. LOQs were below the MCL/cleanup level.

Explosives: The nominal LOQs of 1.00 µg/L were above the MCL/cleanup level of 0.42 µg/L for 24DNT and 26DNT. However, the DLs of 0.25 µg/L were below the MCL/cleanup level, and the lab reported down to the DL.

Metals: The nominal LOQ of 0.020 mg/L was above the MCL/cleanup level of 0.00722 mg/L for vanadium. However, the DL of 0.005 mg/L was below the MCL/cleanup level, and the lab reported down to the DL.

XIV. SAMPLE RESULTS / TRANSCRIPTION VERIFICATION

Transcription between the data package and the EDDs was verified. Results reported below the LOQs but above the DLs were qualified as estimated (J). Non-detect results were reported down to the limits of detection (LODs).

VOCs: No issues.

Perchlorate: No issues.

SVOCs: No issues.

Herbicides: No issues.

Explosives: No issues.

Metals: No issues.

DATA VALIDATION REPORT

Volatile Organic Compounds (VOCs) by USEPA SW-846 Method 8260B
Perchlorate by USEPA SW-846 Method 6850
Full Hazard Characteristic Analysis

Project: USACE Longhorn Army Ammunition Plant (LHAAP), Texas May-June 2018
Project/Task Number: 10097916
Sample Data Package: L18051504, L18060103, L18060355, L18060936
Laboratory: Microbac Labs, Marietta, Ohio
Sample Matrix: Groundwater
Sampling Dates: 23 May – 18 June 2018
Validation Guidelines: Project QAPP *(Final Quality Assurance Project Plan for Longhorn Army Ammunition Plant, Karnack, Texas [July 2014]*); United States Environmental Protection Agency (USEPA) *Test Methods for Evaluating Solid Waste, Physical/Chemical Meth*ods, *3rd edition* (SW-846); *National Functional Guidelines for Inorganic Superfund Data Review (USEPA, September 2016); National Functional Guidelines for Organic Superfund Data Review (USEPA, September 2016)* and professional judgment
Validation Level: Stage 2BVM (100% of data), Stage 3VM (10% of data)
Data Reviewer: Lynn K. Lutz, HDR

Sample ID	Lab ID	VOCs	Per-chlorate	Full Hazard Characteristic
235SB01A	L18051504-01	X	X	
245SB02A	L18051504-02	X	X	
245SB02B	L18051504-05	X	X	
255SB06A	L18051504-06	X	X	
295SB03A	L18060103-02	X	X	
295SB03A MS	L18060103-03	X	X	
295SB03A MSD	L18060103-04	X	X	
295SB03B	L18060103-05	X	X	
305SB04A	L18060103-06	X	X	
305SB05A	L18060103-08	X	X	
305SB05B	L18060103-09	X	X	
056SB07iA	L18060355-05	X	X	
066SB07iB	L18060355-06	X	X	
016SB08iA	L18060103-10	X	X	
016SB08iB	L18060103-11	X	X	
046SB09iA	L18060355-04	X	X	
046SB11iA	L18060355-02	X	X	
046SB11iB	L18060355-03	X	X	
245DUP01	L18051504-04	X	X	
305DUP01	L18060103-07	X	X	
235TB01	L18051504-03	X		
295TB01	L18060103-01	X		
046TB01	L18060355-01	X		
Shallow Composite	L18060936-01			X
Intermediate Composite	L18060936-02			X

SUMMARY

One hundred percent of the data underwent Stage 2BVM level validation. Ten percent of the data underwent Stage 3VM level validation.

Laboratory data were acceptable with qualification as noted below. No data were rejected. Completeness was 100%, which met the goal of 90% for the project.

The Hazard Characteristic data was reviewed at a Stage 2AVM level.

I. SAMPLE RECEIPT / CHAIN OF CUSTODY

The chains of custody (COC) were filled out and signed. Samples were received at 0.0°C to 5.0°C, within the correct temperature range (between 0°C and 6°C). No qualification was required.

II. HOLDING TIMES AND PRESERVATION

VOCs: Samples were analyzed within 14 days of collection. Samples 0165B08A, 056SB07iA and 056SB07iB were received with all three vials having headspace; results for these samples have been qualified as non-detect estimated (UJ) or estimated with a possible low bias (J-). Sample 245SB02B had a pH of 4 at the time of analysis, above the required pH of 2 or less for acid preservation. This sample was analyzed within seven days of collection, the holding time for unpreserved samples, and no qualification was required.

Perchlorate: Samples were analyzed within 28 days of collection. No qualification was required.

Hazard Characteristic: Samples were analyzed within the required holding time except for pH (corrosivity), which was analyzed the day after collection, and pH results have been qualified as estimated (J).

III. SAMPLES ANALYZED

All planned samples were collected and all scheduled analyses were performed. The correct analyte lists were reported. No qualification was required.

VOCs: Samples were analyzed by USEPA SW-846 Method 8260B. Results are reported in µg/L. The analyte list was short, only nine analytes.

Perchlorate: Samples were analyzed by USEPA Method SW-846 6850. Results are reported in µg/L.

Hazard Characteristic: Samples were analyzed for the correct analytes. Results are reported in mg/kg for reactive cyanide and reactive sulfide; mg/L for TCLP mercury; µg/L for TCLP VOCs, SVOCs, herbicides, pesticides and metals; pH standard units for corrosivity; and °C for temperature.

IV. BLANKS

METHOD BLANKS

Target analytes should not be detected in method blanks above the limits of quantitation (LOQs).

VOCs: VOCs were not detected in the MBs. No qualification was required.

Perchlorate: Perchlorate was not detected in the MBs. No qualification was required.

Hazard Characteristic: The analytes were not detected in the MBs. No qualification was required.

TRIP BLANKS
Three trip blanks were collected (235TB1, 295TB1 and 046TB1). Target analytes were generally not detected except as noted below.

VOCs: Acetone was detected in 295TB01 at a trace level, 3.06 µg/L. Acetone detected in the associated samples at less than ten times the trip blank concentration have been qualified as estimated with a possible high bias (J+). The qualified samples were:

Sample ID	Acetone Concentration	Qualifier
295SB03A	10.0 µg/L	J+
295SB03B	7.71 µg/L	J+
305SB04A	5.30 µg/L	J+
305DUP01	5.81 µg/L	J+
305SB05B	2.68 µg/L	J+

Perchlorate: Not applicable.

Hazard Characteristic: Not applicable.

EQUIPMENT RINSE BLANK
Equipment rinse blanks were not collected. No qualification was required.

INITIAL AND CONTINUING CALIBRATION BLANKS (ICBs and CCBs)

VOCs: Not applicable.

Perchlorate: Perchlorate was not detected in the ICBs and CCBs. No qualification was required.

Hazard Characteristic: The analytes were not detected in the ICBs and CCBs. No qualification was required.

V. LABORATORY CONTROL SAMPLES (LCS)
Recoveries and relative percent differences (RPDs) were generally control limits except as noted below.

VOCs: All recoveries and RPDs were within control limits. No qualification was required.

Perchlorate: All recoveries were within control limits. No qualification was required.

Hazard Characteristic: All recoveries and RPDs were within control limits. No qualification was required.

VI. MATRIX SPIKE / MATRIX SPIKE DUPLICATE (MS/MSD)
One sample (295SB03A) was designated on the COC for MS/MSD analysis. Recoveries and RPDs were generally within the laboratory's control limits except as noted below.

VOCs: All recoveries and RPDs were within control limits. No qualification was required.

Perchlorate: The lab also spiked and analyzed samples 235SB01A and 066SB07iB from this project. All recoveries and RPDs were within control limits. No qualification was required.

Hazard Characteristic: Not applicable.

VI. DILUTION TEST AND POST DIGESTION SPIKE (PDS)

A dilution test was performed for analytes detected at least 50 times the concentration of the MRL, and results agreed within ten percent. A post digestion spike (PDS) was performed on samples and the recoveries were between 80 and 120 percent except as noted below. These tests are applicable only to metals by SW6010C.

VOCs: Not applicable.

Perchlorate: Not applicable.

Hazard Characteristic: Not applicable.

VIII. FIELD DUPLICATES

Field duplicate (FD) samples were collected as shown in the table below. Control limits listed in the QAPP were used.

Field Duplicate Sample	Parent Sample
245DUP01	255SB06A
305DUP01	305SB04A

VOCs: All results were within the control limits. No qualification was required.

Perchlorate: Perchlorate in all parent and FD samples was non-detect. No qualification was required.

Hazard Characteristic: Not applicable.

IX. LABORATORY DUPLICATES

Laboratory duplicate (LD) analyses were performed on some samples from this project. Control limits of 20% RPD, or less than the MRL for results less than five times the MRL, as suggested in the Functional Guidelines, were generally met except as noted below.

VOCs: Not applicable.

Perchlorate: No lab duplicate analysis was performed on samples from this project. No qualification was required.

Hazard Characteristic: Lab duplicate analysis was performed for some analyses and results were within control limits. No qualification was required.

X. INSTRUMENT CALIBRATION

INITIAL CALIBRATION

VOCs: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

Perchlorate: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

Hazard Characteristic: Calibration requirements were met. No qualification was required.

INITIAL CALIBRATION VERIFICATION (ICV)

VOCs: ICV results were within the required limits. No qualification was required.

Perchlorate: ICV results were within the required limits. No qualification was required.

Hazard Characteristic: The ICV result for the SVOC analyte pentachlorophenol (PCP) had a percent difference (%D) value of +35.3%, above the required limit of 20%, and with a higher response than the initial calibration. PCP results in the samples were non-detect and have been qualified as non-detect estimated (UJ).

CONTINUING CALIBRATION VERIFICATION (CCV)

VOCs: CCV results were within the required limits. No qualification was required.

Perchlorate: CCV results were within the required limits. No qualification was required.

Hazard Characteristic: CCV results were within the required limits. No qualification was required.

The results for the low level standard verification for the metals barium, lead, cadmium and chromium, with recoveries of 71.3% to 78.8%, were below the required limits of 80-120%. Sample results for lead, cadmium and chromium were non-detect and have been qualified as non-detect estimated (UJ). Sample results for barium were detected and have been qualified as estimated with a possible low bias (J-).

XI. SURROGATES, INTERNAL STANDARDS AND ION RATIOS

VOCs: Internal standard areas and retention times were within required limits. No qualification was required.

The recoveries of the surrogate dibromofluoromethane at 73.7% to 79.7% were below the control limits of 80-118% in five samples. The recoveries of the other three surrogates were within control limits in all five samples. No qualification was required.

Perchlorate: The m/z 83/85 in sample 305SB05A at 2.29 was slightly below the acceptable range of 2.3-3.8. Perchlorate in this sample has been qualified as non-detect estimated (UJ).

Hazard Characteristic: Surrogate recoveries and internal standard results were within control limits and required limits. No qualification was required.

XII. INTERFERENCE CHECK SAMPLES

Interference check sample solutions ICSA and ICSAB were analyzed (methods 6010/6020 only).

VOCs: Not applicable.

Perchlorate: Not applicable.

Hazard Characteristic: Results were within required limits. No qualification was required.

XIII. SAMPLE LIMITS OF QUANTITATION

Limits of quantitation (LOQs) should be less than the applicable cleanup levels as listed in the project QAPP.

VOCs: VOC LOQs were below the cleanup levels.

Perchlorate: Perchlorate LOQs were below the cleanup level.

Hazard Characteristic: LOQs were below the regulatory limits.

XIV. SAMPLE RESULTS / TRANSCRIPTION VERIFICATION

Transcription between the data package and the EDDs was verified. Results reported below the LOQs but above the detection limits (DLs) were qualified as estimated (J).

VOCs: No issues.

Perchlorate: No issues.

Hazard Characteristic: No issues.

DATA VALIDATION REPORT

Volatile Organic Compounds (VOCs) by USEPA SW-846 Method 8260B
Perchlorate by USEPA SW-846 Method 6850
Semivolatile Organic Compounds (SVOCs) by USEPA SW-846 Method 8270C
Herbicides by USEPA SW-846 Method 8151A
Explosives by USEPA Method 8330B
Metals by USEPA SW-846 Methods 6010C and 6020

Project: USACE Longhorn Army Ammunition Plant (LHAAP), Texas September 2018
Project/Task Number: 10097916
Sample Data Package: L18091525
Laboratory: Microbac Labs, Marietta, Ohio
Sample Matrix: Groundwater
Sampling Dates: 16-18 September 2018
Validation Guidelines: Project QAPP *(Final Quality Assurance Project Plan for Longhorn Army Ammunition Plant, Karnack, Texas [July 2014]*); United States Environmental Protection Agency (USEPA) *Test Methods for Evaluating Solid Waste, Physical/Chemical Meth*ods, *3rd edition* (SW-846); *National Functional Guidelines for Inorganic Superfund Data Review (USEPA, September 2016); National Functional Guidelines for Organic Superfund Data Review (USEPA, September 2016)* and professional judgment
Validation Level: Stage 2BVM (100% of data), Stage 3VM (10% of data)
Data Reviewer: Lynn K. Lutz, HDR

Sample ID	Lab ID	Matrix	VOCs	Per-chlorate	SVOCs	Herbs	Explo-sives	Metals
180947WW09	L18091525-14	GW	X	X	X	X	X	X
160947WW37	L18091525-02	GW	X		X	X		X
160947WW38	L18091525-01	GW	X	X	X	X		X
170947WW40	L18091525-11	GW		X				
170947WW41	L18091525-12	GW	X	X				
180947WW42	L18091525-13	GW	X				X	
170947WW43	L18091525-10	GW	X	X			X	
170947WW44	L18091525-04	GW	X	X				
170947WW45	L18091525-05	GW	X	X				
170947WW45 MS	L18091525-06	GW	X	X				
170947WW45 MSD	L18091525-07	GW	X	X				
170947WW46	L18091525-09	GW	X	X				
170947WW47	L18091525-03	GW	X	X				
DUP-04	L18091525-08	GW	X	X				
TB-03	L18091525-15	QC Water	X					
EB-02	L18091525-16	QC Water	X	X	X	X	X	X

SUMMARY

One hundred percent of the data underwent Stage 2BVM level validation. Ten percent of the data underwent Stage 3VM level validation.

Laboratory data were acceptable with qualification as noted below. No data were rejected. Completeness was 100%, which met the goal of 90% for the project.

I. SAMPLE RECEIPT / CHAIN OF CUSTODY

The chains of custody (COC) were filled out and signed. Samples were received within the correct temperature range (between 0°C and 6°C). No qualification was required.

II. SAMPLES ANALYZED

All planned samples were collected and all scheduled analyses were performed. The correct analyte lists were reported. No qualification was required.

VOCs: Samples were analyzed by USEPA SW-846 Method 8260B. Results are reported in µg/L.

Perchlorate: Samples were analyzed by USEPA Method SW-846 6850. Results are reported in µg/L.

SVOCs: Samples were analyzed by USEPA SW-846 Method 8270C. Only bis(2-ethylhexyl)phthalate was requested and reported. Results are reported in µg/L.

Herbicides: Samples were analyzed by USEPA SW-846 Method 8151A. Only pentachlorophenol (PCP) was requested and reported. Results are reported in µg/L. Pentachlorophenol was analyzed by the herbicide method SW8151A rather than the SVOC method 8270C in order to achieve a limit of quantitation (LOQ) below the regulatory limit.

Explosives: Samples were analyzed by USEPA SW-846 Method 8330B. Only 2,4,6-trinitrotoluene (246TNT), 2,4-dinitrotoluene (24DNT) and 2,6-dinitrotoluene (26DNT) were requested and reported. Results are reported in µg/L.

Metals: Samples were analyzed by USEPA SW-846 Method 6010C and 6020. Results are reported in mg/L. Aluminum, chromium, cobalt, manganese, nickel, silver, strontium, tin and vanadium were analyzed by method SW6010C. Antimony, arsenic, cadmium and thallium were analyzed by method SW6020.

III. HOLDING TIMES AND PRESERVATION

All holding time criteria were met and no qualification was required except as noted below.

VOCs: Samples were analyzed within 14 days of collection.

Two samples analyzed for volatiles (170947WW41 and 170947WW43) were at pHs of 5 and 3, respectively, above the required pH of less than 2 for acid preserved samples. These samples were analyzed past the seven day holding time for unpreserved samples, and results have been qualified as non-detect estimated (UJ) or estimated (J).

Perchlorate: Samples were analyzed within 28 days of collection. No qualification was required.

SVOCs: Samples were extracted within seven days of collection and analyzed within 40 days of extraction. No qualification was required.

Herbicides: Samples were extracted within seven days of collection and analyzed within 40 days of extraction. No qualification was required.

Explosives: Samples were extracted within seven days of collection and analyzed within 40 days of extraction. No qualification was required.

Metals: Samples were analyzed within 180 days of collection. No qualification was required.

IV. BLANKS

METHOD BLANKS

Target analytes were not detected in method blanks except as noted below.

VOCs: A trace level of trichloroethene (TCE) was detected in one MB (WG677954). Sample results associated with this blank were well above the blank concentration and no qualification was required.

Perchlorate: Perchlorate was not detected in the MBs. No qualification was required.

SVOCs: Bis(2-ethylhexyl)phthalate was not detected in the method blanks. No qualification was required.

Herbicides: PCP was not detected in the MBs. No qualification was required.

Explosives: Explosives were not detected in the method blanks. No qualification was required.

Metals: Metals were not detected in the method blanks. No qualification was required.

TRIP BLANKS

VOCs: One trip blank was collected (TB-03). TCE was detected at 1.79 µg/L, above the limit of quantitation (LOQ) of 1.0 µg/L. TCE in five associated samples (160947WW38, 170947WW41, 170947WW44, 170947WW46 and 170947WW47) was detected at less than five times the blank and has been qualified as estimated with a possible high bias (J+).

Perchlorate: Not applicable.

SVOCs: Not applicable.

Herbicides: Not applicable.

Explosives: Not applicable.

Metals: Not applicable.

EQUIPMENT RINSE BLANK

One equipment rinse blank (EB-02) was collected. Target analytes were generally not detected except as noted below.

VOCs: TCE was detected in EB-02 above the LOQ, at 1.10 µg/L. TCE in five associated samples (160947WW38, 170947WW41, 170947WW44, 170947WW46 and 170947WW47) was detected at less than five times the blank and has been qualified as estimated with a possible high bias (J+).

Acetone was detected in EB-02 at a trace level (2.68 µg/L). Acetone in six associated samples (180947WW42, 170947WW43, 170947WW44, 170947WW45, 170947WW47 and DUP-04) was

detected at less than 10 times the blank and has been qualified as estimated with a possible high bias (J+).

Chloroform was detected in EB-02 at a trace level (0.524 µg/L). Chloroform in the associated samples was either non-detect or detected at greater than five times the blank concentration, and no qualification was required.

Perchlorate: Perchlorate was not detected in EB-02. No qualification was required.

SVOCs: Bis(2-ethylhexyl)phthalate was not detected in EB-02. No qualification was required.

Herbicides: PCP was not detected in EB-02. No qualification was required.

Explosives: Explosives were not detected in EB-02. No qualification was required.

Metals: Metals were not detected in EB-02. No qualification was required.

INITIAL AND CONTINUING CALIBRATION BLANKS (ICBs and CCBs)

VOCs: Not applicable.

Perchlorate: Perchlorate was not detected in the CCBs. No qualification was required.

SVOCs: Not applicable.

Herbicides: Not applicable.

Explosives: Not applicable.

Metals: Manganese was detected at a trace level in one CCB. Manganese in the associated field samples was detected well above the blank concentration. No qualification was required.

V. LABORATORY CONTROL SAMPLES (LCS)

Recoveries and relative percent differences (RPDs) were generally within control limits except as noted below.

VOCs: The recovery of vinyl chloride at 143% was above the control limits of 58-137% in one LCS (WG677954). Vinyl chloride was detected in one associated sample (180947WW42) and has been qualified as estimated with a possible high bias (J+).

Perchlorate: Recoveries were within control limits. No qualification was required.

SVOCs: Recoveries and RPDs were within control limits. No qualification was required.

Herbicides: Recoveries and RPDs were within control limits. No qualification was required.

Explosives: Recoveries and RPDs were within control limits. No qualification was required.

Metals: Recoveries were within control limits. No qualification was required.

VI. MATRIX SPIKE / MATRIX SPIKE DUPLICATE (MS/MSD)

VOCs: Sample 170947WW45 was designated on the COC for MS/MSD analysis. All recoveries and RPDs were within control limits. No qualification was required.

Perchlorate: Sample 170947WW45 was designated on the COC for MS/MSD analysis. The recoveries at 74.5% and 72.5% were below the control limits of 84-119%. Perchlorate was not detected in the parent sample and has been qualified as non-detect estimated (UJ).

SVOCs: No sample was designated on the COC for MS/MSD analysis. The lab did not spike any samples from this project. No qualification was required.

Herbicides: No sample was designated on the COC for MS/MSD analysis. The lab did not spike any samples from this project. No qualification was required.

Explosives: No sample was designated on the COC for MS/MSD analysis. The lab did not spike any samples from this project. No qualification was required.

Metals: No sample was designated on the COC for MS/MSD analysis. The lab did not spike any samples from this project. No qualification was required.

VI. DILUTION TEST AND POST DIGESTION SPIKE (PDS)

A dilution test was performed for analytes detected at least 50 times the concentration of the MRL, and results agreed within ten percent. A post digestion spike (PDS) was performed on samples and the recoveries were between 80 and 120 percent except as noted below. These tests are applicable only to metals by SW6010C and SW6020.

VOCs: Not applicable.

Perchlorate: Not applicable.

SVOCs: Not applicable.

Herbicides: Not applicable.

Explosives: Not applicable.

Metals: The dilution test and PDS were not performed on any sample from this project. No qualification was required.

VIII. FIELD DUPLICATES

Field duplicate (FD) samples were collected as shown in the table below. Control limits listed in the QAPP were used.

Field Duplicate Sample	Parent Sample
DUP-04	170947WW45 (VOCs and perchlorate)

VOCs: Results were within the control limits. No qualification was required.

Perchlorate: Results were within the control limits. No qualification was required.

SVOCs: No field duplicate was collected for this analysis. No qualification was required.

Herbicides: No field duplicate was collected for this analysis. No qualification was required.

Explosives: No field duplicate was collected for this analysis. No qualification was required.

Metals: No field duplicate was collected for this analysis. No qualification was required.

IX. LABORATORY DUPLICATES

Laboratory duplicate (LD) analyses were not performed on any samples from this project.

X. INSTRUMENT CALIBRATION

INITIAL CALIBRATION

VOCs: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

Perchlorate: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

SVOCs: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

Herbicides: The calibration curve included a standard at or below the LOQ. Calibration requirements were met. No qualification was required.

Explosives: The calibration curve included a standard at the LOQ. Calibration requirements were met. No qualification was required.

Metals: The calibration curve included a standard at the LOQ. Calibration requirements were met. No qualification was required.

INITIAL CALIBRATION VERIFICATION (ICV)

VOCs: ICV results were within the required limits. No qualification was required.

Perchlorate: ICV results were within the required limits. No qualification was required.

SVOCs: ICV results were within the required limits. No qualification was required.

Herbicides: ICV results were within the required limits. No qualification was required.

Explosives: ICV results were within the required limits. No qualification was required.

Metals: ICV results were within the required limits. No qualification was required.

CONTINUING CALIBRATION VERIFICATION (CCV)

VOCs: CCV results were within the required limits. No qualification was required.

Perchlorate: CCV results were within the required limits. No qualification was required.

SVOCs: CCV results were within the required limits. No qualification was required.

Herbicides: CCV results were within the required limits. No qualification was required.

Explosives: CCV results were within the required limits. No qualification was required.

Metals: CCV results were within the required limits. No qualification was required.

XI. SURROGATES, INTERNAL STANDARDS AND ION RATIOS

VOCs: Internal standard areas and retention times were within required limits. Surrogate recoveries were within control limits. No qualification was required.

Perchlorate: The m/z 83/85 ratios of 2.11 in sample WW44 and 2.06 in sample WW43 were outside the acceptable range of 2.3-3.8. These sample results have been qualified as non-detect estimated (UJ).

SVOCs: Internal standard areas and retention times were within required limits. Surrogate recoveries were within control limits. No qualification was required.

Herbicides: Surrogate recoveries were within control limits. No qualification was required.

Explosives: Surrogate recoveries were within control limits. No qualification was required.

Metals: Internal standard results were within required limits. No qualification was required.

XII. INTERFERENCE CHECK SAMPLES

Interference check sample solutions ICSA and ICSAB were analyzed (methods 6010C and 6020 only).

VOCs: Not applicable.

Perchlorate: Not applicable.

SVOCs: Not applicable.

Herbicides: Not applicable.

Explosives: Not applicable.

Metals: All recoveries were within the required limits. No qualification was required.

Silver was detected in one ICSA (unspiked) solution above the LOQ. All sample results for silver were non-detect and have been qualified as non-detect estimated (UJ).

XIII. SAMPLE LIMITS OF QUANTITATION (LOQs)

Limits of quantitation (LOQs) should be less than the applicable cleanup levels as listed in the project QAPP.

VOCs: LOQs were below the groundwater MCLs/cleanup levels.

Perchlorate: LOQs were below the groundwater MCLs/cleanup levels.

SVOCs: The nominal LOQ of 10 µg/L was above the MCL/cleanup level of 6 µg/L. However, the detection limit (DL) of 3 µg/L was below the MCL/cleanup level, and the lab reported down to the DL.

Herbicides: Pentachlorophenol was analyzed by the herbicide method SW8151A rather than the SVOC method 8270C in order to achieve a limit of quantitation (LOQ) below the regulatory limit. LOQs were below the MCL/cleanup level.

Explosives: The nominal LOQs of 1.00 µg/L were above the MCL/cleanup level of 0.42 µg/L for 24DNT and 26DNT. However, the DLs of 0.25 µg/L were below the MCL/cleanup level, and the lab reported down to the DL.

Metals: The nominal LOQ of 0.020 mg/L was above the MCL/cleanup level of 0.00722 mg/L for vanadium. However, the DL of 0.005 mg/L was below the MCL/cleanup level, and the lab reported down to the DL.

XIV. SAMPLE RESULTS / TRANSCRIPTION VERIFICATION

Transcription between the data package and the EDDs was verified. Results reported below the LOQs but above the DLs were qualified as estimated (J). Non-detect results were reported down to the limits of detection (LODs).

VOCs: No issues.

Perchlorate: No issues.

SVOCs: No issues.

Herbicides: No issues.

Explosives: No issues.

Metals: No issues.

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H

Geologic Cross Sections

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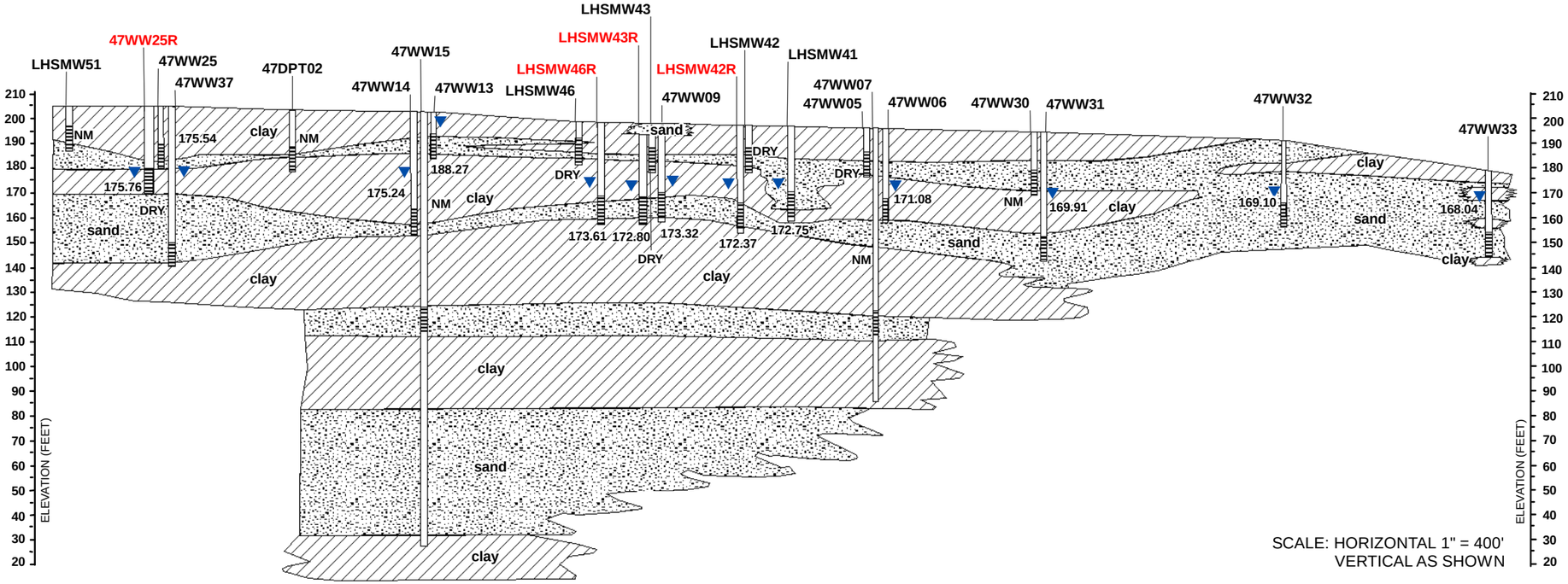

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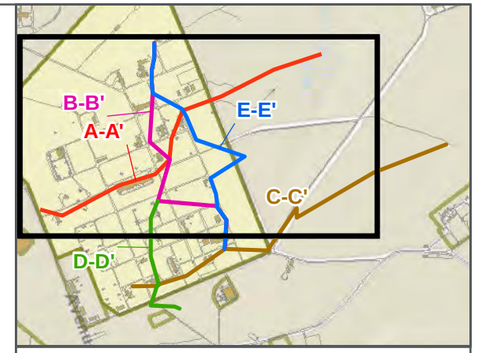
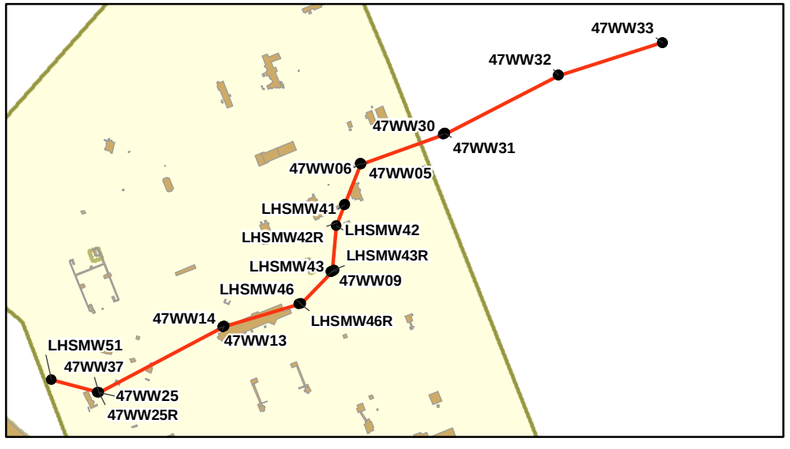


LEGEND

- Screen
- Well
- Sand
- Clay
- Groundwater Elevation (September 2018)



NOTES: * = July 2018 water level
NM = Not Measured
Cross-sections were digitized from 2011 Shaw Feasibility Study
Red font indicates PSI wells

DATA SOURCES: ESRI

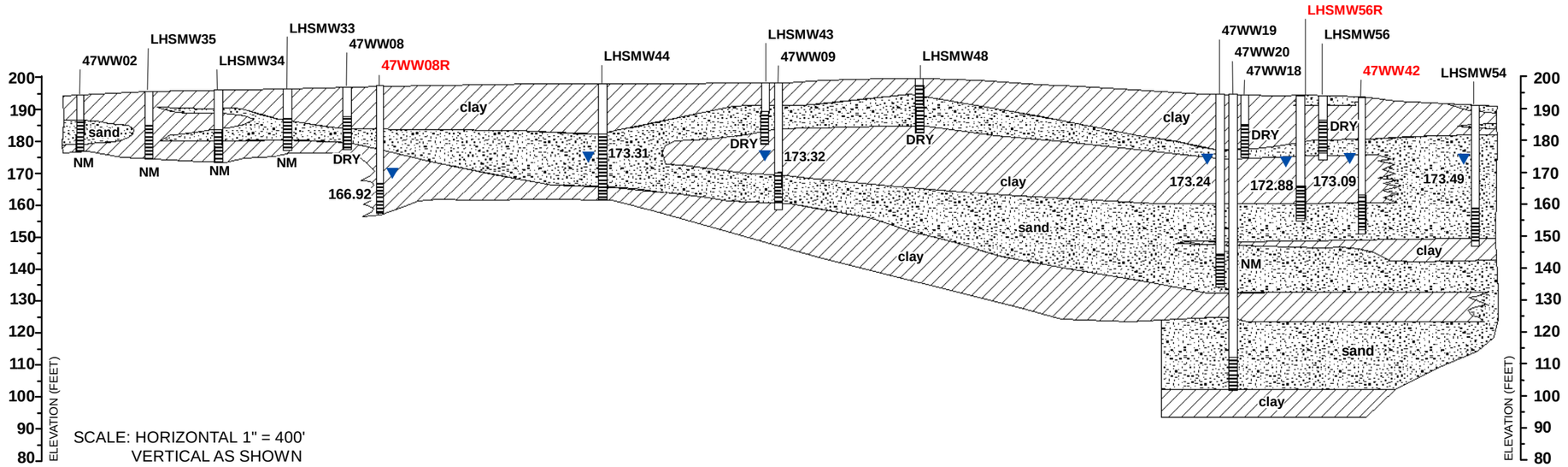
DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

GEOLOGICAL CROSS-SECTION A-A'

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PATH: J:\2018\18-025_LHAAP_SITES29_47_18AND24_ROD_(WERNER)\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\LHAAP47\SCRATCH\XSECTIONS\LHAAP47_SITE_XSECTION_A-A.MXD - USER: EBOWLIN - DATE: 3/14/2019

00916341



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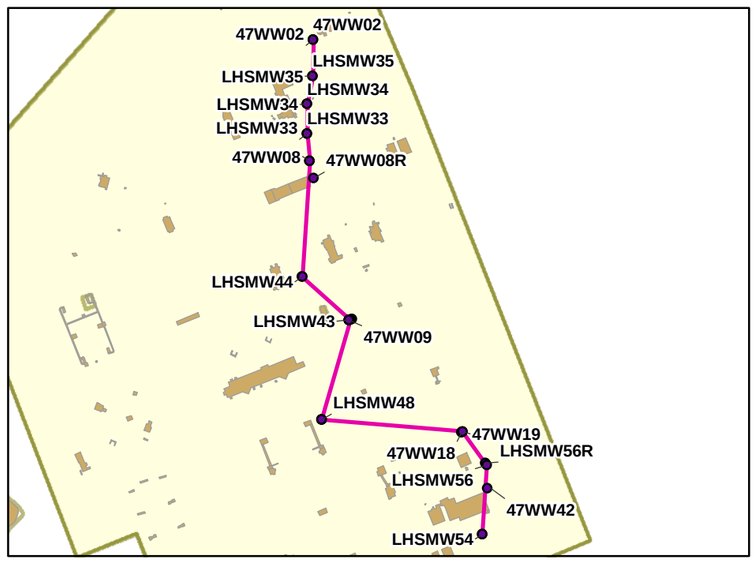
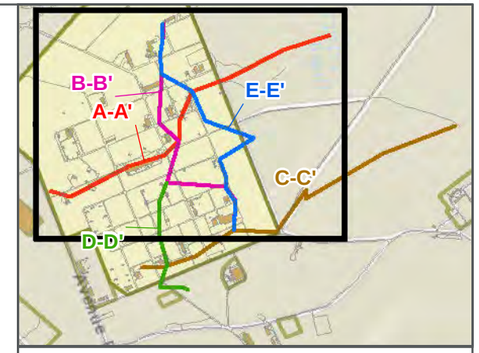




LEGEND

- Screen
- Well
- Sand
- Clay
- Groundwater Elevation (September 2018)

NOTES: NM = Not Measured
Cross-sections were digitized from 2011 Shaw Feasibility Study
Red font indicates PSI wells

DATA SOURCES: ESRI

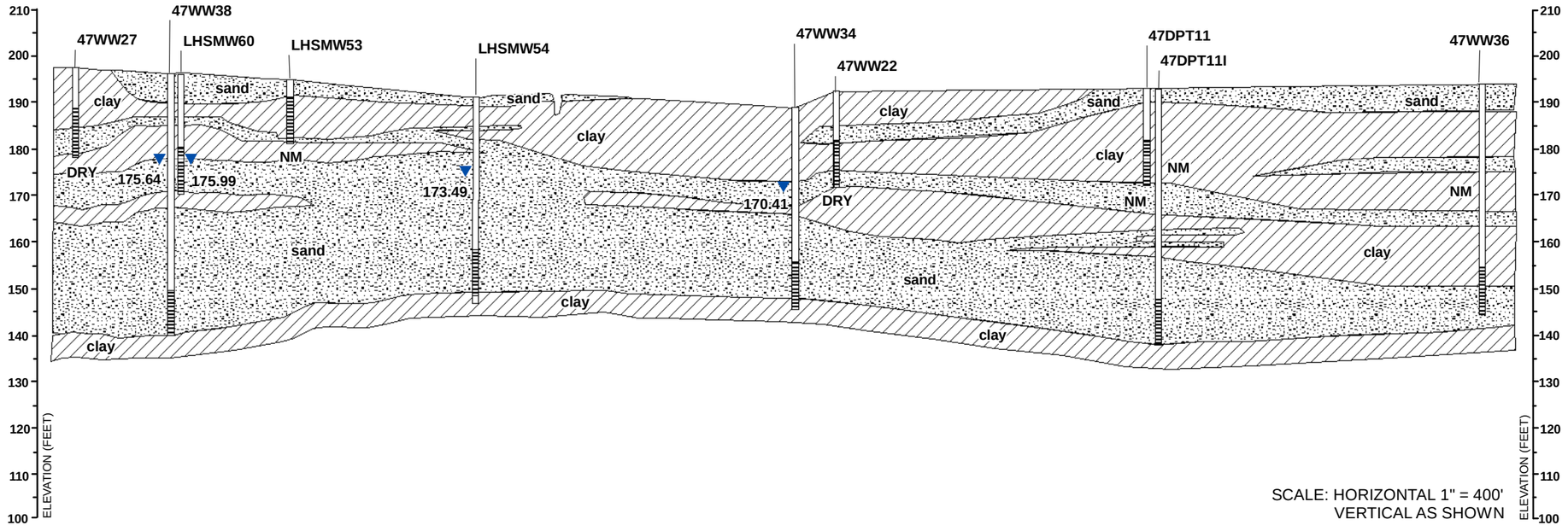
DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

GEOLOGICAL CROSS-SECTION B-B'

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PATH: J:\2018\18-025_LHAAP_SITES29_47_18AND24_ROD_(WERNER)\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\LHAAP47\SCRATCH\XSECTIONS\LHAAP47_SITE_XSECTION_B-B.MXD - USER: EBOWLIN - DATE: 3/14/2019

00916342



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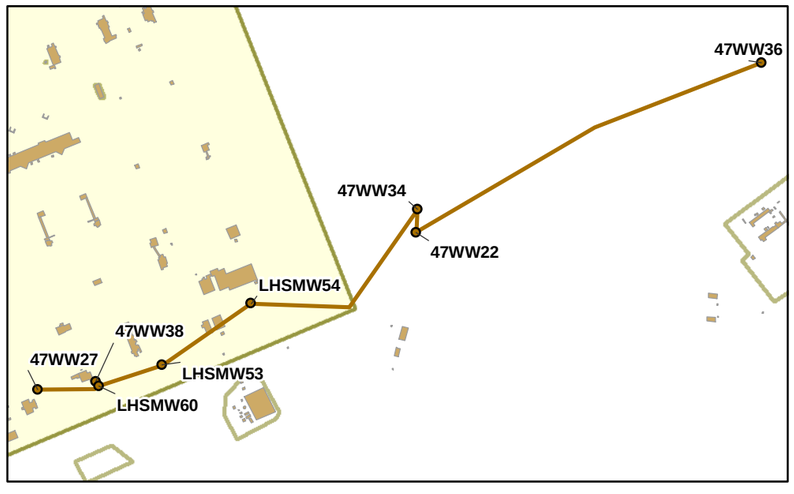

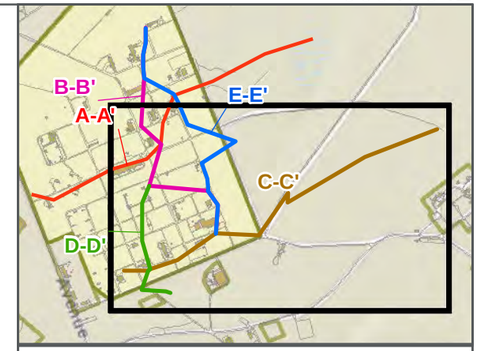

LEGEND

- Screen
- Well
- Sand
- Clay
- Groundwater Elevation (September 2018)

NOTES: NM = Not Measured
Cross-sections were digitized from 2011 Shaw Feasibility Study

DATA SOURCES: ESRI

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

GEOLOGICAL CROSS-SECTION C-C'

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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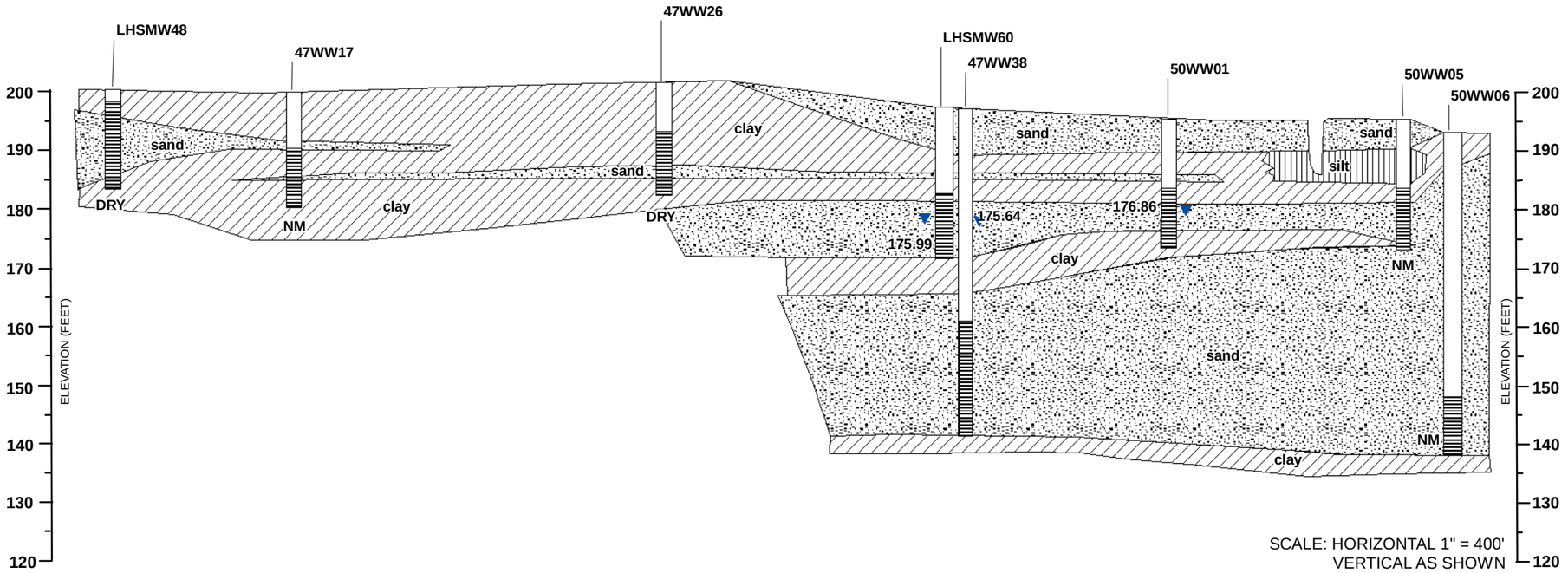
00916343



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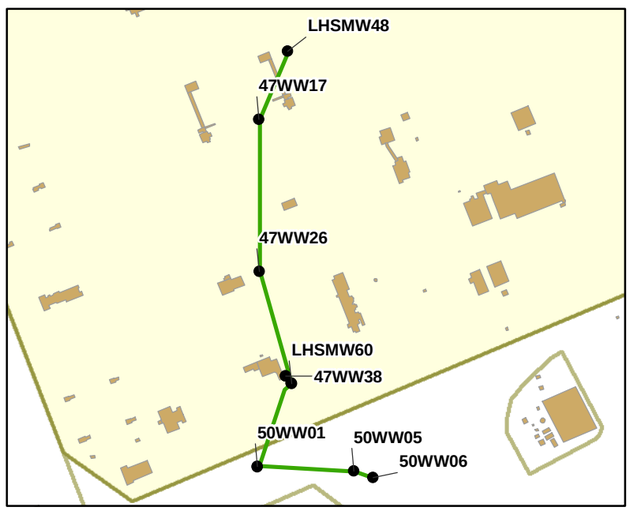
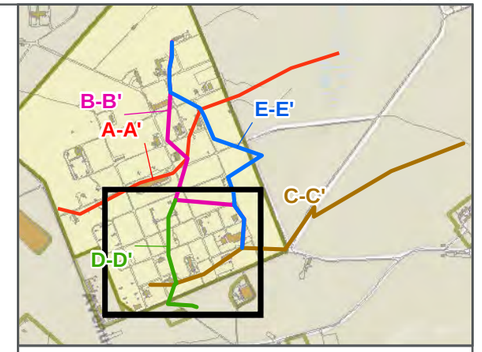
VERTICAL AS SHOWN





LEGEND

- Screen
- Well
- Silt
- Sand
- Clay
- Groundwater Elevation (September 2018)

NOTES: NM = Not Measured
Cross-sections were digitized from 2011 Shaw Feasibility Study

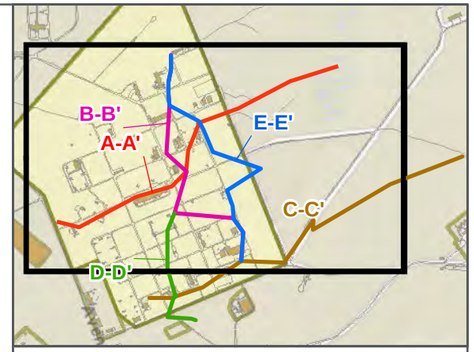
DATA SOURCES: ESRI

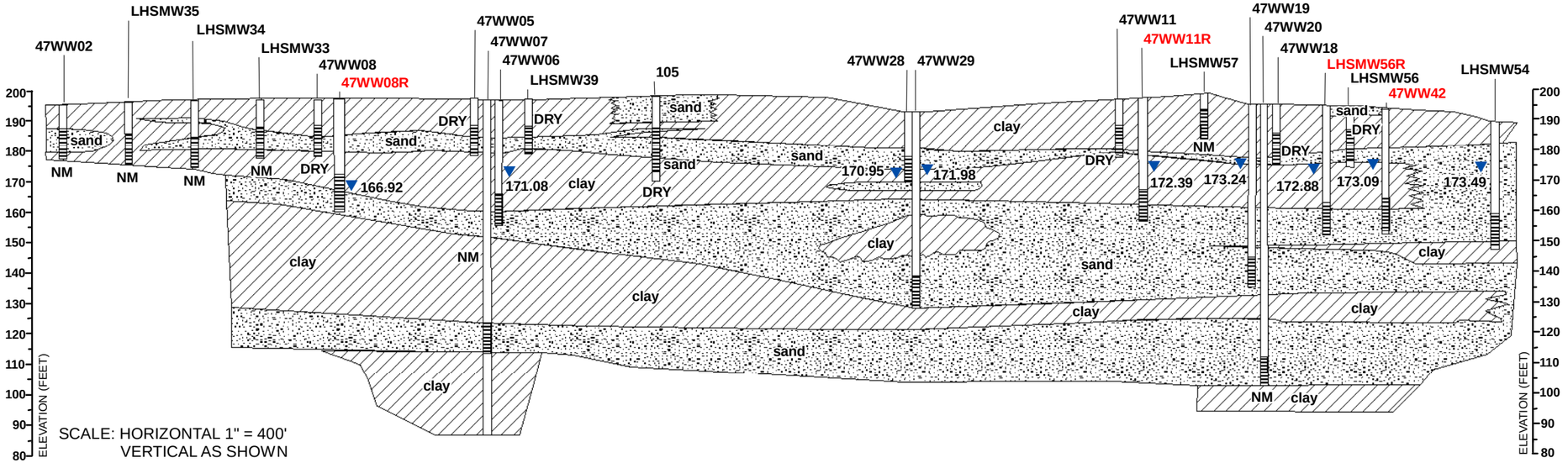
DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

GEOLOGICAL CROSS SECTION D-D'

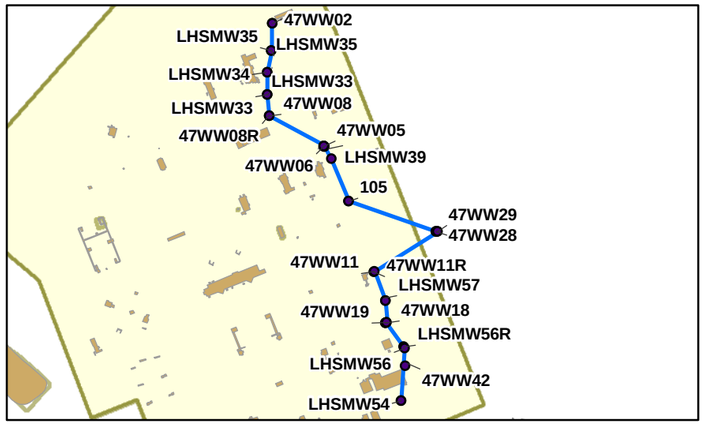
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PATH: J:\2018\18-025_LHAAP_SITES29_47_18AND24_ROD_(WERNER)\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\LHAAP47\SCRATCH\XSECTIONS\LHAAP47_SITE_XSECTION_D-D.MXD - USER: EBOWLIN - DATE: 3/14/2019





SCALE: HORIZONTAL 1" = 400'
VERTICAL AS SHOWN



LEGEND

- Screen
- Well
- Sand
- Clay
- Groundwater Elevation (September 2018)

NOTES: NM = Not Measured
Cross-sections were digitized from 2011 Shaw Feasibility Study
Red font indicates PSI wells

DATA SOURCES: ESRI

DISCLAIMER: Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

GEOLOGICAL CROSS-SECTION E-E'

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

PATH: J:\2018\18-025_LHAAP_SITES29_47_18AND24_ROD_(WERNER)\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\LHAAP47\SCRATCH\XSECTIONS\LHAAP47_SITE_XSECTION_E-E.MXD - USER: EBOWLIN - DATE: 3/15/2019